THE
PRACTICAL MAGAZINE

No. 15. Vol. 3, 1874.

SIR TITUS SALT, BART., OF SALTAIRE.

EVERYBODY—or, at least, everybody who professes to be anybody—must have heard of Saltaire. It is to Yorkshire what the Pyramids were to Egypt, what the walls and hanging gardens were to Babylon, what the Temple of Diana was to Ephesus, what the Colossus was to Rhodes, what the statue of the Olympian Jupiter was to Athens, what the Mausoleum was to Rome—the greatest of its many wonders. What the Spaniards say of Seville, Yorkshiremen may say of Saltaire, "He who has not seen it has missed something worth seeing." Considered as the work of one man, and that man dependent entirely upon his own unaided resources, it is a marvellous creation—a nation in miniature, a little kingdom within a kingdom. Saltaire is, perhaps, the most perfect approximation the old world can produce of that ideal of social comfort and well-regulated industrial relations of which philosophers have dreamt and poets sung for many generations. It is a model which is not only worthy of imitation, but which, if it were generally followed, would furnish to this country all the elements of power, civilization, and happiness that are now absent. A century of

legislation would probably fail to do for England all that Sir Titus Salt has done for Saltaire. A community in which labour is honoured and industry encouraged—in which domestic comfort is secured by admirable sanitary arrangements, by commodious and well-built houses, and by all the amenities that can make a happy home—in which intellectual and scientific culture is stimulated and facilitated by appliances that even most of our large cities fail to furnish—in which æsthetic taste is fostered by every surrounding—in which sobriety is inculcated by the banishment of intoxicating liquors—in which old age is cared for by the establishment of palatial almshouses, thus relieving poverty without the demoralizing and unsympathetic control of "parochial" rules and regulations—in which the education of poor and rich alike is not only provided for but insisted upon. Such is Saltaire in some of its leading aspects; and it needs no great discernment to understand that if the same happy set of circumstances could be applied to the country at large, crime would be banished, morality would be stimulated, ignorance with its hydra-headed and pernicious influences would be almost impossible, and the manifold evils of pauperism would be unknown. At Saltaire, therefore, four of the most important problems of imperial legislation and administration have been effectually solved. The highest function of legislation—the greatest good of the greatest number—can only be attained by results such as have here been achieved.

Saltaire is situated on the main line of the Midland Railway, about three miles distant from Bradford, and ten miles from Leeds. It is built upon a hill sloping downwards to the Aire, and takes its name from that river, conjoined to that of its founder, Sir Titus Salt. The site of the town is admirably chosen, commanding as it does a wide and beautiful prospect of the Aire Valley, with the wooded slopes of Hope Hill on the opposite side, and the famous Shipley Glen in the immediate neighbourhood. But these were rather accidental than intentional advantages. The founder of Saltaire selected the site primarily because it afforded singular facilities for carrying on industrial operations. On one side of the Saltaire mills there is the main line of the Midland Railway; on the other there is the Leeds and Liverpool Canal; and close at hand the sluggish and undulating Aire flows through the valley. Here, therefore, were to be found, without trouble, two of the most essential *desiderata* in all manufacturing operations—facilities of transport and an abundant supply of water.

The Saltaire mills were opened on the 20th day of September, 1853, the day on which their founder attained his fiftieth year. For many years previously Sir Titus Salt (then Mr. Salt) had been engaged as a manufacturer at Bradford, where his father was a woollen dealer before him. When he had attained years of discretion, Titus joined his father in business; and the firm, taking the style of Daniel Salt and Son, speculated largely in Russian Donskir wool. Although this product had only been used in the woollen trade until that time, it occurred to Daniel Salt, or his son, or both of them, that it might be advantageously applied to the worsted trade. The Bradford spinners, however, would have nothing to do with it, and it only remained for Titus—as the managing partner of the firm—either to give it up altogether, or start works of his own for its fabrication. Confident in the merits of the commodity which others rejected, he established works of his own in Bradford, and carried on for a number of years a successful business as a spinner and manufacturer in what is known as Thompson's Mill, Silsbridge Lane, Bradford. Subsequently he purchased or rented the Holling's Mill, the Brick Lane Mill, the Beecroft Mill, and the Union Street Mill, all in Bradford. But these mills were some distance apart, and this fact involved much inconvenience and trouble that would have been avoided by their centralization. It was with this consideration in view, therefore, that Mr. Salt resolved to build the new works at Saltaire, which, as we have seen, were opened in the year 1853.

The Saltaire Factory.

Every one who has travelled between Scotland and England, or *vice versâ*, on the Midland Railway, must have seen and admired the Saltaire Mills. They are not, perhaps, so large as the Merrimac cotton factory in Lowell, with its 2,538 power looms and its 140,000 spindles; nor may they rival the great Newhall factory in Glasgow, with its 150,000 spindles, consuming about 70,000 lbs. of cotton fibre per week, and running off thread at the rate of 300 miles per minute. But in all the other accessories of grandeur and greatness the Saltaire Factory will rival, if it does not excel, every other industrial establishment of the same description in the United Kingdom. The Saltaire works are built entirely of a light coloured freestone quarried in the immediate neighbourhood; and the architecture is of a bold Italian style. The site covers nine acres, one rood, and twenty-seven perches of ground, and the floors of the different buildings extend to eleven and a half acres, or 55,000 yards. Some of the walls are from two to three feet in thickness. The main buildings take the shape of the letter T, the perpendicular stroke representing the warehouses, which run northwards to the bank of the Leeds and Liverpool canal, a distance of 330 ft. The horizontal stroke represents the mill proper, which is 550 ft. in length, and 72 ft. in height above the level of the railway. The angles of the T are filled in with weaving sheds. The principal building, commonly called the mill, is six storeys high, and is chiefly devoted to the spinning of the yarn, out of which the fabrics which have made the name of Salt so famous, are manufactured. The upper storey is open from one end to the other, and is one of the largest rooms in the world. Its length is 540 ft. by 40 ft. wide. It is noteworthy that this room furnishes probably as good an idea as it is possible to obtain of the immense size and capacity of the Great Eastern steamship; and when it is remembered that that remarkable triumph of marine architecture is 100 ft. longer and 10 ft. wider than this vast apartment, one cannot but marvel at the skill and daring that framed such a huge leviathan. Returning from this digression, we notice that there are 100 spinning frames in this upper storey, each frame containing 144 spindles. There is an abundant flood of light shed upon the workers below from a glass roof, and hoists provide communication between the different storeys. The floors are based upon arches of hollow brick, supported by rows of cast-iron columns and beams.

The engine-houses attached to the Saltaire mills are in some respects unique. They are placed in the centre of the main building already referred to, and face the railway, so that passengers can obtain from the line some idea of their magnificence. There are two engine-houses, with a pair of beam engines in each. All the engines are of the same size, the cylinder being 50 in. diameter, and the length of stroke 7 ft. They have a boiler pressure of 40 lbs. and make thirty revolutions per minute. The engines indicate about 1000 horse-power. The makers are Hick, Hargreaves, and Co., the well-known engineers of Bolton. The Corliss principle, as applied by Sir William Armstrong, is one of the chief features of these engines, which are also fitted with Spenser and Inglis' patent expansion motion. There is no throttle valve, and practically the whole of the boiler pressure, or at all events within half a pound, is got with the piston at the commencement of the stroke. The ponderous fly-wheels each weigh 40 tons; the crank shafts, with necks 16 in. diameter, are made of steel, and the cranks are made of wrought iron. At the instance of the Messrs. Salt, a pair of engines very similar to these have been fitted up in the Allan liner "Circassian," and have given every satisfaction. Another vessel of the same size and class was at the same time fitted up with the ordinary compound marine engine; and when the results of the two systems were compared, it was found that the single engines of the "Circassian," having less friction than the compound engines, performed a greater quantity of work with a less consumption of fuel. The Saltaire engines are furnished with Ashton and Storeys' continuous indicator, respecting which there was an article in a recent number of "Naval Science." This indicator possesses a great advantage over all others, inasmuch as it not only indicates every stroke made by the engine, but it brings out the result in foot pounds. The firmness and stability of the engine houses are secured by two massive box-girders going right through the walls above the beam centres, while on either side there are bolts fixed into the entablature, and going down about fifty feet, where they are fixed to another large casting which passes under the wall. These and similar details sufficiently explain the solidity and firmness of the engine-houses, where there is scarcely so much vibration experienced as one would expect from a donkey-engine of three or four horse-power.

From a strictly artistic point of view, the Saltaire engines and engine-houses supply an interesting subject of study. Everyone who has had any general experience of English engines, and of the places provided for their reception, will be able to call to remembrance, in a more or less vivid degree, that they produced sensations the reverse of pleasurable. The engines might be powerful, and their houses might be vast; but the former were invariably dirty and dull, with only a few streaks of light where steel mountings were essential, while the latter were dreary, gloomy, and uninviting, with bare walls, bad floors, and a pervading aspect of squalor and nastiness. But at Saltaire everything is as bright as a new pin, and the engines and engine-houses supply one—and that not the least important—of the many points in which this model establishment might be imitated with advantage. Commencing *ab initio*, we find that the doors and the whole front of the engine-houses are constructed of plate-glass, through which, as we have already indicated, the engines can be seen at work from the railway. Inside, everything appears to have been arranged with a special eye to artistic effect. A huge chandelier, that might grace any hall or dining-

room, hangs pendent from the roof, which is supported on four Corinthian pillars painted imitation marble, the acanthus leaves of the capitals being painted in gold and other colours. There is a great deal of steel and brass about the engines, burnished so brightly that the effect is exceedingly light and pleasing. The cylinders are encased in oak, and reach to the level of the first floor, which is attained by a handsome iron staircase. A second staircase of similar construction brings us to the level of the beams on the second floor, and a passage through this elevation communicates, *viâ* a repairing shop, where a number of mechanics are employed, with the second engine-house, which is almost in all respects a *fac-simile* of the first.

To the south of the engine-houses, and somewhat nearer the railway, the boilers are situated. They are built in an excavation about 15 ft. below the level of the ground. Altogether there are eleven boilers, two of them being of very large size—12 ft. diameter by 24 ft. long—with two fire-boxes, each 5 ft. diameter. Each of these two boilers is fitted with fifty-six Galloway tubes and ten pockets, and will drive 500 indicated horse-power. A clock-work arrangement opens and shuts Venetians connected with the fire-doors, which are so constructed as to consume the smoke generated in the furnace, by the regulated admission of the air. These boilers, we may add, are the patent of Broadbent, of Manchester, and they appear to furnish a conjunction of advantages that have long been sought for—especially an economy of fuel, and the simple though effectual consumption of their own smoke. A water-meter is attached to the boilers for testing the consumption and economy of coal. By this arrangement it is easily discovered what kind and price is the most economical, for the water-meter tells with unfailing certainty whether this or that coal will evaporate a thousand gallons at the lowest cost.

The weaving-sheds are not the least interesting feature of the Saltaire mills. The largest shed covers about two acres of ground, and contains more than a thousand looms. Unlike the looms used in the manufacture of cotton, the alpaca looms vary materially in size; but most of them are so much larger than ordinary cotton looms, that of the latter size of loom this shed would hold nearly as many more. It is a singular characteristic of this shed that all the gearing—straps, belts, pulleys, and shafting—is underground, and we are inclined to believe that this is the first weaving-shed in which this admirable arrangement was adopted. Sloping skylights, constructed in the form of bays, admit an abundance of light to the weaving-sheds; and there is an underground arrangement for regulating the temperature of the building by the admission of hot or cold air at pleasure. The looms used at Saltaire are made by Mr. George Hodgson, of Bradford, and are similar in construction to the ordinary worsted loom employed throughout the country.

At each end of the large mill there are rooms for drawing the wool by roving machines. This operation is also identical in kind with that adopted in woollen factories generally; but as the alpaca staple is larger than ordinary staples, being 10 to 12 in. in length, larger roving machines are required for its reduction.

In the western angle of the works there is an immense shed filled with combing machines. Beneath this shed an enormous filter and reservoir is placed, capable of holding 500,000 gallons of water, into which the rain from the roofs of all the circumjacent buildings is conducted, and afterwards used for the scouring of the wool. Another large iron tank, capable of holding 70,000 gallons of water, is placed on the top of the warehouses, in order to supply the means of extinguishing any fire that may happen to arise. The most thorough precautions are taken to avoid this danger, all the buildings being fire-proof and roofed with iron; but, after the recent devastating fire at the Pantechnicon, which was professedly a fire-proof building, it is obvious that the mere fact of being fire-proof, as that term is usually understood, will not suffice to preserve a building from destruction.

The large wool warehouses, which run northward from the centre of the great front line, and form the perpendicular of the letter T, are 330 ft. in length, and six storeys high. The ground upon which these warehouses are built slopes downwards to the canal, so that the end of the warehouses rises 90 ft. from the level of the water, or 18 ft. higher than the principal front. Underneath the warehouses there is a place for washing the wool by machines made by M'Naught, of Manchester. In the wool warehouses about 150 men are employed in sorting, their earnings averaging 30*s.* per week. Parallel with the end of the warehouses a long gallery or tunnel with a glass roof gives access to the other side of the canal, where there is a second mill, of more recent erection, and containing about 18,000 spindles.

There are two principal entrances to the Saltaire works, both facing the north-west. One is designed for the operatives, and the other for clerks, visitors, and others. The offices have a frontage to the north-west of 240 ft. On one side of the gateway which forms the principal entrance, there are the private offices of the firm, which are large, extensive, and splendidly furnished. On the other side there is the office of the Cerberus who jealously guards the portals from impertinent intruders; the store-house, containing nearly every article that can be purchased in an ironmonger's shop, and a great many more besides; and the printing office, where all the printing work required by the firm is executed by their own *employés*.

A large cooking establishment is attached to the Saltaire mills, where all kinds of refreshments—beer and spirituous liquors excepted—are supplied *à prix fixe*. In this place about 700 workpeople dine every day, and they dine both cheaper and better than they could at home for the same charge. A dinner of three courses, served up in a way that the principals themselves could hardly take exception to, is supplied for $5\frac{1}{2}d.$ or 6*d.*, and an excellent breakfast or tea can be had for 3*d.* The cooking *dépôt* is a great boon to those of the *employés* who reside at Shipley, Bradford, and other places at a distance from the works—for there are a number of the 4,000 hands employed at Saltaire who prefer or have occasion to reside elsewhere. The *dépôt* is supplied with a number of daily and other newspapers, and as the proprietors have neither established nor carried it on with any view to profit, the workmen get the benefit of the economy that accrues from victualling on a large scale.

All the smoke generated about the works is conducted by underground flues to a chimney at the eastern extremity. This chimney is 250 ft. high—its base being 18 ft. square—and it is so constructed as to resemble an Italian campanile. In the centre of the flue, between the boiler-house and the chimney, there is a Green's Economiser, through which the water passes on its way to the boilers in chambers which provide a passage for the smoke of the furnaces, so that the water is delivered to the boilers at a high temperature.

To the north-east of the mills there is a large gasworks, which supplies 100,000 ft. per day for over 5,000 lights in the mill, sheds, and other parts of the works, together with the houses in Saltaire, and the street lamps. The largest of the two gasometers is 60 ft. in diameter, and 18 ft. deep, and the gasworks are built on what is known as White's hydro-carbon system.

Messrs. Lockwood and Mawson, of London and Bradford, are the architects of the Saltaire mills, which (notwithstanding that they have constructed the well-known St. George's Hall, and other noble buildings in Bradford and elsewhere) have been described as their greatest work. Sir William Fairbairn was the engineer, and it is interesting to reproduce here part of a speech which he made on the occasion of the opening of the works in 1853. "He had," he said, "taken some little pains to ascertain what were their capabilities, and he found that the nominal power of the steam engines was equal to 400 horses; but working them up to a pressure of 40 lbs. on the square inch, they would give a force of upwards of 1,200 horse power. The length of shafting to be set in motion before all the machinery could be put in operation was 9870 ft. or nearly two miles, and it weighed between 600 or 700 tons. All that immense mass of matter must be put and kept in motion before they could give power or force to the various machines which would be fixed in different parts of the building. He had also ascertained that it would contain 1,200 looms, capable of producing 30,000 yards of alpaca cloth or mixed goods per diem, or nearly 18 miles of cloth each day. This would give a length of 5,688 miles of cloth per annum, which, as the crow flies, would reach over the land and the sea to Peru and the native mountains of the alpaca."

Writing in 1854, Sir William Fairbairn, in his work on "The application of cast and wrought iron to building purposes," says, "I select for illustration the gigantic establishment at Saltaire, not more on account of its general completeness, than as a means of conveying to the mind of the general reader some idea of the vast energies, resources, and confidence which are brought to bear upon the development of manufacturing industry by the more advanced and enlightened men who are engaged in the manufacture of textile fabrics. It is impossible to visit the neighbourhood and these busy hives; to survey the silent and uniform action of the great motive powers; to listen to the constant and confusing din of spindle and loom; to be informed of the number of human beings employed under one roof; and the amount of their earnings, and the astounding total of their produce; and to reflect farther upon the enterprise and talent which must be in constant action both abroad and nearer home, to keep this great whole supplied and at work,—without admiring the intellect that can guide such a work, and feeling thankful for that national security and prosperity which justifies such a risk."

There are some more minute details of the Saltaire works which should not pass unnoticed. The windows are glazed with sheets of large plate glass, the upper part being hung on pivots, and opening so as to admit air and exclude rain. Ventilation is provided for by flues in the walls and arches for the admission of fresh air, while other flues provide for the escape of the vitiated

air. In winter the rooms are warmed by steam pipes. Long lines of ventilators in the roofs are worked and regulated simultaneously by a simple arrangement of a rod, a wheel, and levers. Three-inch pipes are connected with each stack of privies and lead into the chimney flue, thus removing all obnoxious effluvia. The effect of all these arrangements has been to secure an average rate of health that cannot be surpassed by any factory in the United Kingdom. On this phase of the subject, a medical report, which will be found at page 194 of the Reports on the Paris Universal Exhibition, 1867, vol. 6, may be studied with advantage.

Children commence to work at Saltaire when they are only eight years of age, but until they reach thirteen they only work half time—that is to say, they spend one half of their day at the mill, and the other half at school. These "half-timers" make from 2*s.* 3*d.* to 4*s.* per week, and get their schooling free. When they commence to work full time in the mills, their wages rise to 8*s.* and 10*s.* per week; and when they reach the age of sixteen, and often a couple of years earlier, they are transferred from the spinning to the weaving department, where their wages will reach as high as 15*s.* per week. The weaving looms are chiefly attended to by girls, but there are also many men employed. As a rule, two looms are managed by a man, and only one by a girl, so that the former is able to earn considerably more than the latter.

The factory operatives at Saltaire commence at six in the morning, and leave off at six in the evening, with two hours between for breakfast and dinner. By the Factory Act work must be discontinued at two o'clock on Saturday afternoon; but the Messrs. Salt voluntarily allowed their operatives to suspend their Saturday's work an hour sooner.

The great bulk of the fabrics manufactured at Saltaire is forwarded per rail to Liverpool for shipment to all parts of the world; but the Leeds and Liverpool Canal is also used to a large extent for the purposes of transport. It is interesting to remark that when Sir Titus commenced the Saltaire works, the Midland Railway hastened to acquire the control of the Leeds and Liverpool Canal at a rental of £40,000 per annum, with the object of exacting high dues on the produce of the Saltaire mills. But Sir Titus was not a man that would submit tamely to the extortion of a monopoly, and he told the railway company that he had fully determined to cart all his stuff to and from Bradford, and give some of the other railways connected with that town the benefit of his freightage unless the Midland became more reasonable. This threat brought the Midland Company to their senses, and a tariff was mutually agreed upon which has since continued in operation with reciprocal advantage. The Midland Company's lease of the Leeds and Liverpool Canal is now nearly at an end; but it is scarcely believed that the arrangement which they were so eager to close in 1853 has proved so advantageous as to induce the railway to effect its renewal.

The Origin and Manufacture of Alpaca.

Having described the Saltaire mills as fully as our space will allow, we next come to speak of their fabrics. Our remarks will necessarily chiefly refer to the alpaca, with the introduction of which into this country the name of Sir Titus Salt is indissolubly associated. It is a common error to suppose that the qualities of alpaca wool, and its adaptability for the purposes of textile fabrics, were unknown until Sir Titus Salt found them out. The fact is that, although Sir Titus is undoubtedly entitled to the credit of being the first to introduce it into this country and adapt it for commercial uses, the qualities of alpaca wool were known at least so far back as 1811, for we find that in that year a work was published by one named William Walton, which stated that there were four kinds of Peruvian sheep, including the llama, the huanaco, the vicuna or vigonia, and the alpaca; and pointed out that the alpaca staple was of extraordinary length and of a soft and glossy consistency. This description is quite correct so far as it goes. The alpaca is an animal of the llama tribe, inhabiting the mountain regions of Peru. The wool or hair is of various shades, including black, white, grey, and brown. It is remarkable for brightness of lustre and extreme softness. The bulk of alpaca goods are made with cotton warp, and when dyed and finished they approach silk in lustre and brilliancy, as every member of the fair sex is fully aware. The story of the circumstances that led to the introduction of alpaca into this country in 1836 by Sir Titus Salt has been described in his customary humorous vein by the late Mr. Charles Dickens in "Household Words." The story is worth reproduction. The great novelist says:—

"A huge pile of dirty-looking sacks, filled with some fibrous material, which bore a strong resemblance to superannuated horse-hair, or frowsy elongated wool, or anything unpleasant or unattractive, was landed at Liverpool. When these queer-looking bales had first arrived, or by what vessel brought, or for what purpose intended, the very oldest warehouseman in Liverpool docks couldn't say. There had once been a rumour—a mere warehouseman's rumour—that the bales had been shipped from South America, on spec., and consigned to the agency of C. W. and F. Foozle and Co. But even this seems to have been forgotten, and it was agreed upon by all hands, that the three hundred and odd sacks of nondescript hair wool were a perfect nuisance. The rats appeared to be the only parties who approved at all of the importation, and to them it was the finest investment for capital that had been known in Liverpool since their first ancestors had emigrated thither. Well, these bales seemed likely to rot, or fall to the dust, or be bitten up for the particular use of family rats. Merchants would have nothing to say to them. Dealers couldn't make them out. Manufacturers shook their heads at the bare mention of them. While the agents of C. W. and F. Foozle and Co., looking at the bill of lading,—had once spoken to their head clerk about shipping them to South America again.

"One day—we won't care what day it was, or even what week or month it was, though things of far less consequence have been chronicled to the half minute—one day, a plain business looking young man, with an intelligent face and quiet reserved manner, was walking along through these same warehouses in Liverpool, when his eye fell upon some of the superannuated horse-hair projecting from one of the ugly dirty bales. Some lady rat, more delicate than her neighbours, had found it rather coarser than usual, and had persuaded her lord and master to eject the portion from her resting place. Our friend took it up, looked at it, felt it, rubbed it, pulled it about; in fact he did all but taste it, and he would have done that if it had suited his purpose—for he was 'Yorkshire.' Having held it up to the light, and held it away from the light, and held it in all sorts of positions, and done all sorts of cruelties to it, as though it had been his most deadly enemy and he was feeling quite vindictive, he placed a handful or two in his pocket, and walked calmly away, evidently intending to put the stuff to some excruciating private torture at home. What particular experiments he tried with this fibrous substance I am not exactly in a position to state, nor does it much signify; but the sequel was that the same quiet business looking young man was seen to enter the office of C. W. and F. Foozle and Co., and ask for the head of the firm. When he asked that portion of the house if he would accept eightpence per pound for the entire contents of the three hundred and odd frowsy dirty bags of nondescript wool, the authority interrogated felt so confounded that he could not have told if he were the head or the tail of the firm. At first he fancied our friend had come for the express purpose of quizzing him, and then that he was an escaped lunatic, and thought seriously of calling for the police, but eventually it ended in his making it over in consideration of the price offered."

From 1836 (when Sir Titus Salt first commenced the importation of alpaca wool) to 1840, the quantity sent into England was 7,000 bales per annum. From 1841 to 1845 the annual importation increased to 13,000 bales; and from 1846 to 1850, the imports were 20,000 bales per annum. Since then the quantity has largely augmented, until now it is not much short of 40,000 bales annually, although in 1850 it was believed that 20,000 bales per annum was the utmost extent of the production of Peru.

Another material very largely imported by Sir Titus Salt, and made into textile fabrics of different kinds at the Saltaire works, is mohair or goat's wool, which is produced extensively in Asia Minor. In its raw state mohair is superior to alpaca, and it has been largely exported from this country to the Continent, where it has superseded the yarn formerly spun in Turkey, being manufactured into Utrecht velvet, for hangings and for the linings of carriages and the covering of furniture. The importation of mohair increased from 5,621 bales in 1841 to 12,884 bales in 1850; and since the latter year its increase has been almost correspondingly great.

The next principal fleece used at the Saltaire Works is the Russian Donskor fleece, to which allusion was made in the early part of this paper. This wool is of a very coarse fibre, and is chiefly used for the manufacture of marines—a strong fabric, resembling watered silk, which is used for bed-hangings and for the making up of ladies' petticoats. It is a very cheap material and wears well.

The following table shows the quantities of these wools imported into England for a period of years:—

Imports of Turkey Goat's Wool (or Mohair) for the last Ten Years.

	180 lbs. each.		180 lbs. each.
1864	20,087 bags.	1869	22,718 bags.
1865	27,441 „	1870	14,190 „
1866	22,074 „	1871	44,149 „
1867	15,374 „	1872	31,904 „
1868	37,559 „	1873	35,248 „

Imports of Alpaca Wool for the last Sixteen Years.

		125 lbs. each.			125 lbs. each.
1858	.	26,969 packages.	1866	.	31,953 packages.
1859	.	24,111 „	1867	.	30,319 „
1860	.	35,417 „	1868	.	19,177 „
1861	.	30,458 „	1869	.	23,963 „
1862	.	29,377 „	1870	.	28,555 „
1863	.	32,537 „	1871	.	37,000 „
1864	.	23,848 „	1872	.	28,626 „
1865	.	25,695 „	1873	.	36,487 „

Imports of Russian Wool for the last Ten Years.

		360 lbs. each.			360 lbs. each.
1864	. .	37,829 bales.	1869	. .	22,161 bales.
1865	. .	37,147 „	1870	. .	18,474 „
1866	. .	45,021 „	1871	. .	42,662 „
1867	. .	21,258 „	1872	. .	37,836 „
1868	. .	24,727 „	1873	. .	31,403 „

The alpaca wool comes into the hands of the Messrs. Salt—for the firm includes three sons of Sir Titus as well as himself—packed in bales, each weighing 180 lbs., and two bales are joined together so as to be easily carried on the backs of the animals used as beasts of burden in South America. The animal chiefly employed in Peru to carry these bales to the port of shipment is the llama itself, which is much stronger than the alpaca and makes an excellent beast of burden. The fleeces are afterwards sorted into six or ten different qualities, according to the various stuffs for which they are specially adapted. After being thoroughly well washed, the alpaca is given to the comber, and in the process to which he subjects it there is an ordinary waste of a pound and a half per stone of sixteen pounds. Technically speaking, a single stone of sorted alpaca will yield from ten to eleven pounds of top—the material adapted for spinning, leaving about three pounds for "noil." The top is sent to the preparing room, and put through the usual slivering or "slivery box," perfected by an improved "gill" made specially for this class of work. The ordinary colours afterwards go through the ordinary processes of preparing, roving, and spinning, in the course of which an admixture of the "sliverings" gives the beautiful variety of shades and colours so common to alpacas. It is stated that in these processes the sliverings, drawings, and slubbings are mixed or doubled no fewer than 20,971,520 times before the top (or the produce of the comber) is converted into the finished hank or yarn. In the weaving sheds to which it is next passed, the yarn is woven into fabrics of different qualities, according to the value of the stuffs. After coming from the looms the finished fabrics are examined by the "taker in," a functionary whose business it is to see if the carelessness of the weaver has caused any defects in the piece. Should the piece pass muster, it is folded up for the purposes of sale or dyeing; but as a rule the fabrics are sent in this state to the merchant or salesman, who sends them to the dyer and finisher to be completed as he has a mind, or as the caprice of his customers may dictate. Only white cloths are sent to the dyer, the self colours being given over to the finisher, who steams, singes, crabs, and presses them until they assume a beautiful gloss and are guaranteed against shrinking. At Saltaire the average work of an alpaca weaver is about three pieces per week, each piece consisting of about forty yards; but four or even more pieces may be done in a week of an inferior sort.

To supply an inventory and description of the different fabrics produced at Saltaire would be a laborious and difficult task. Briefly, they comprise Parisians, damasks, poplins, mohairs, lustings, crapes, Orleans, casinetts, twills, French figures, merinos, camlets, coburgs, challis, mousseline-de-laines, paramattas, shalloons, duroys, taminets, Khybereens, bombazines, figured satteens, cubicas, fancy waistcoatings, robes for ladies' dresses, and figured and embroidered alpacas. This list includes nearly all the stuffs to be found in the ample catalogue of the Bradford woollen trade, which has wonderfully expanded within the last ten or twenty years. The time is still within the memory of living men when the worsted trade of Bradford was confined to camlets, serges, russets, jammies, calimancos, and one or two other stuffs of that class, woven by hand-loom at the houses of the weavers. In 1815 there were only ten mills in Bradford, with an aggregate of 256 horse-power. In 1825 there were twenty-six mills; in 1835 Bradford contained 73 mills; and sixteen years ago, 186 of the 525 worsted factories in Great Britain were situated in Bradford, and employed 30,517 hands. The Saltaire works, therefore, only furnish one of the most remarkable examples of the development of the busy town from which they took their rise.

General Aspect of Saltaire.

The construction of houses for the domiciliary requirements of his workpeople is necessarily one of the first considerations that occurs to a manufacturer in establishing new works in a new district. So far as the Saltaire Works were concerned, the great bulk of the operatives might easily have been housed at Shipley, about a mile distant, or at Bradford, which is only three miles away. But the founder of Saltaire had made up his mind to provide for his workpeople not only employment, but every other resource of social, moral, and intellectual well-being. According to a well-matured and carefully considered plan, he proceeded to carry out his intentions. Saltaire was, in common parlance, built "in the lump;" it was not put together in shreds and patches—here a little and there a little, without any uniformity of design, as nearly all other towns have sprung into existence. The houses were all built after the same model, according to their rents and the class of operatives they were intended to accommodate. Every house was erected with due regard to sanitary needs, being well ventilated, and having back yard accommodation, water, gas, and other conveniences to itself. The streets were laid out with the same scrupulous regard to order, "the first law of nature." Built of a uniform width, they open out of each other at right angles, and are kept in admirable condition by scavengers employed by the firm. All the streets running north to south—twelve in number—are named after the members of the family of Sir Titus, as William, Henry, George, Amelia, Edward, Fanny, Herbert, Whitlam, Mary, Helen, and Ada streets. There are seventeen streets running east to west, some of them having only half-a-dozen and others as many as thirty-nine houses. The principal thoroughfares are Victoria Road and Albert Road, running north to south, and Albert Terrace and Gordon Terrace, running east to west. The town covers an area of over twenty-five acres, and contains nearly 900 dwellings. At the census taken on the 1st of April, 1871, the population of Saltaire was 4,389, the proportion of the sexes being 2,003 males to 2,386 females.

The houses in Saltaire are chiefly let from week to week, and their management is undertaken by a committee of workmen, who meet every Wednesday, and let any houses that may be vacant. The commonest class of houses, with a front parlour, a sitting-room, kitchen, two bed-rooms, and back and front door, with all necessary conveniences, are let weekly at 3*s.* to 3*s.* 6*d.*, including all rates and taxes. A better class of house, with three bed-rooms and a garden in front, is let for 5*s.* per week, or 2*s.* to 3*s.* per week less than the same sort of house would let for in Bradford. The houses are all built of stone, which gives them a much more light and cheerful appearance than that belonging to the everlasting red brick cottages of the north of England.

Although not a teetotaller himself, Sir Titus was sufficiently well aware of the importance of temperance and sobriety as conditions of social welfare and prosperity, to forbid the erection of beer-shops or public-houses of any kind in Saltaire. To a large extent the prohibition has realized its intention. But it must not be supposed that the use of intoxicating liquors is altogether unknown to the people of Saltaire. Men and women cannot be cajoled or forced into habits of virtue and sobriety; and as there are black sheep in every flock, so there are at Saltaire those who seek to defeat the wise and excellent purpose of their employer and friend by patronizing the beer-shops at Shipley and Bradford. Nor was it possible for Sir Titus to prevent, as he doubtless otherwise would have done, the erection of a public-house immediately outside the borders of his own property; for a beer-house has been erected on the opposite side of the Shipley Road, and within a stone's throw of the centre of Saltaire. But these temptations notwithstanding, the community of which Sir Titus is the head, have been so far influenced by his example, and by the discouragement of the use of spirituous liquors, that they are perhaps further removed from drunkenness and crime than any other community in the kingdom.

The Institutions of Saltaire.

The Saltaire Club and Institute is one of those noble and beneficent foundations due to the liberality and paternal forethought of an employer who did not consider—as employers generally are wont to do—that his obligations towards his workpeople terminated with the payment of their wages, and that outside business hours they had no more claim upon him than if they lived in Fiji or Dahomey. One of the most distinguishing traits in the character of the Saltaire baronet is his high ideal of the relations that should subsist between employers and employed; and his active and benevolent interest in the social and moral condition of his workpeople. Not content with providing for them all that was necessary to ensure physical health and comfort, he resolved to put them in possession of the means of mental culture, so that there should be no excuse for igno-

rance, nor any pretext for the waste of time or the lapse of virtue. His views and intentions were given effect to by the erection of the Saltaire Club and Institute, which was completed in June, 1871, at a cost of £18,366, although the furnishing account will represent some thousands more. A more magnificent or a more complete educational establishment does not exist within the limits of the United Kingdom. Both in its external aspect, and in its internal accessories, the institute is almost unique. Its accommodation includes—

1. A large reading room, 35 ft. by 53.
2. A large and well fitted library.
3. A laboratory.
4. Chess and draught rooms.
5. Smoking rooms.
6. A large billiard room with four tables by Orme and Sons of Manchester.
7. A bagatelle room.
8. A lecture hall capable of seating 800 persons.
9. A lecture theatre to seat 200.
10. A school of art, containing a large and valuable collection of models.
11. A gymnasium and drill hall.
12. Class-rooms.

The institute is situated in Victoria Road, from the line of which it is thrown back about forty feet. It is enclosed by a massive iron railing, at the angles of which there are two massive lions, which were originally sculptured for the Nelson Monument in Trafalgar Square, by Thomas Milnes. The lions are emblematical of war and peace. A tower rises from the base or front, in semi-relief. The building consists of three floors, including the basement. The first-floor windows are flanked by fluted Corinthian columns with florid capitals, supporting semi-circular eaves, which bear a head in the centre, and are attached by an embellished ledge. Above the principal doorway, which is approached by a sweeping flight of steps, there are two sculptured female figures, representing art and science. The central tower terminates in the form of an angular cone. The most remarkable feature of the interior is the lecture hall, which is decorated in a style that has seldom been attempted in this country. Its architecture is Roman Corinthian; and the decorations, in pure Pompeian style, have been applied in the exact manner for which the room was originally designed. The style of ornamentation has thus been carried out consistently with the architectural features, and the harmonious effect, although scarcely so striking as some specimens of the style, is yet of a most gorgeous and elaborate description. The surbase running round the room to the window sills, a height of about five feet, is divided into large black panels upon which stencilled patterns in cream colours are displayed. The flat surfaces of the walls have been painted Pompeian red, and the mass of this colour, so bold and strong, is as effectually broken up by the windows, as by the numerous Corinthian pilasters, which each rise from a small red panel in the surbases. The pilasters themselves are each divided into three panels. The upper and lower panels, which are black, are filled in with masks in flesh colour, representing the arts and sciences—agriculture, navigation, chemistry, mechanics, astronomy, painting, music, architecture, sculpture, &c. The capitals of the pilasters are in green bronze, relieved in the background with blue, the tips being brought out with gold. The windows of the room are circular-headed, and up the sides of the recesses stencilled ornaments in red are carried, while the sashes are gold bronze. The ornamentation of the walls, as will be seen by the above details, is both elaborate and varied, and the elements both of colour and design being all in perfect character, an effect is produced which defies description. In the orchestra, where two sets of coupled pilasters divide the wall into three parts, a centre panel is formed between the two sets of pilasters, and upon it is painted a floating figure, somewhat over life-size, representing music. The frieze of the cornice is painted maroon, with the names of the most celebrated musical composers, in large gold letters, arranged chronologically, Handel, very appropriately, occupying the position over the orchestra. The cornice and architrave are richly decorated in colours, and relieved with gold. From the top of the cornice rise the ribs and panels of the ceiling, which is divided in compartments by beams running right across, which are richly ornamented in gold and colours. Each of the compartments between the beams is sub-divided into octagonal panels, with the stiles in cream colour, and the flats in grey.

In other parts of the institute the same style of decoration has been carried out, although on a less extensive scale. The walls of the school of art and the billiard room are in Pompeian red, and the walls of the class rooms, reading room, library, and staircases, are pale green. The interior, as a whole, is decorated in a manner and with an amount of taste that would put to the blush many of our more pretentious metropolitan institutions, public and private. The architects of the Saltaire Institute are Messrs. Lockwood and Mawson, who also designed the St. George's Hall at Bradford. In the upper part of the building there are two schools—one of an elementary, and the other of an advanced, character. The latter is in connection with the South Kensington Science and Art Department, as are also the science classes carried on in the same building. In the billiard room, which measures 35 ft. by 53 ft., no intoxicating liquors are allowed, but tea, coffee, and temperance beverages generally, may be obtained. Threepence per game of fifty is charged for billiard playing, and last year over £100 was obtained from this source. There are over 1000 members connected with the institute. The committee of management consists of eight members appointed by Messrs. Titus Salt and Sons, and an equal number appointed by the members of the institute. The fees for membership are nominal, men above twenty-one years of age paying 2*s.* per quarter; above eighteen and under twenty-one, 1*s.* 6*d.*; boys, above thirteen and under eighteen, 1*s.*; women, above eighteen years (for whom sewing classes will be established), 1*s.*; and girls, above thirteen and under eighteen, 6*d.* The constitution of the institute is thoroughly liberal, and is open to all who choose to avail themselves of its advantages. The curriculum is wide and of a high standard, embracing reading, writing, arithmetic, geography, grammar, drawing, chemistry, needlework, and gymnastics. The large hall is utilized for other than purely institute purposes, being used for lectures, readings, concerts, and other entertainments of an approved description. Several rooms have been allotted for the use of societies not connected with the institute—such as friendly and benefit societies, the object of this provision being to afford the members of such societies an opportunity of meeting together in the institute instead of in beerhouses. The rooms are let for 3*d.* a night—a sum which cannot pay for the gas consumed; and the privilege has been so much appreciated by the various societies, that some difficulty has been experienced in meeting their numerous calls for accommodation. The institute is let to the committee of management for a nominal rent of 4*s.* per annum.

Saltaire does not know what it is to have people "on the parish." If Betty Higden, poor soul! had lived here, she would have got rid of the fear that perpetually oppressed her high and independent mind, of being ultimately dependent on parochial relief. To provide for the aged and infirm of Saltaire, and for all who would otherwise be compelled to seek parish aid, Sir Titus has built at the upper end of the town a series of forty-five almshouses, capable of providing for sixty residents. Bumbledom could scarcely conceive of a greater contrast than these almshouses furnish to the common workhouse, nor would those who are legally, but often by a sad perversion of language, termed the "guardians of the poor," be likely to imitate (even if they could) this novel mode of "remembering their case." The laws of England provide for our poor being domiciled under conditions that render their lives almost intolerable: fed on the coarsest fare, treated with scarcely an iota of sympathy or consideration, deprived, to a large extent, of personal liberty, and regarded as public incumbrances to be got rid of as soon and as easily as possible, it is little wonder that nothing short of absolute desperation, and a loss of all self-respect, will allow the children of misfortune to seek for parochial aid. But Sir Titus Salt and his family have taken for the rule of their conduct a higher and a more beneficent law than the law of England. It is by the law of humanity that they have moulded their actions; and recognizing that poverty in itself is no reproach, and that misfortune in itself is no disgrace, they have provided for the reception of their poor dependents everything that can promote the amenities of life and render tolerable a condition of dependence. The almshouses which they have built are in the style of Italian villas, with gardens in front. They are fitted up with ovens, boilers, pantries, and all conveniences. A chapel and infirmary are attached to the almshouses; and of course the almsmen and almswomen have as little restraint put upon their personal liberty as if they resided in houses of their own. The following regulations of these almshouses describe their constitution, and are worthy of reproduction as a model on which the rules of other institutions of a similar character may advantageously be framed:—

1. The occupants may be either men or women, and either single, married, or widowed.

2. The almshouses will, so far as the occupants are concerned, be free from rents and taxes, and the obligation to make repairs other than such as may be rendered necessary by the wilful act of any occupant, will rest alone upon the founder and his trustees.

3. Each married almsman residing with his wife in one of the almshouses shall receive a weekly allowance of 10*s.*; and each almsman or almswoman living there without a wife or husband,

shall receive the weekly allowance of *7s. 6d.*, which allowances will be paid weekly.

4. No person shall be appointed or chosen to be an occupant of one of the almshouses unless he or she be a person of good character, destitute of property, or other means sufficient for his or her support, and incapacitated for labour by reason of age, disease, or infirmity, so as to be unable to earn his or her own living.

5. The almspeople will be appointed by the founder during his life, and after his death by the trustees for the time being.

6. Any applicant for nomination of election shall send to the founder during his lifetime, and after his decease to the trustees, an application in writing, stating his or her name, age, occupation, and place or places of residence during one year preceding such application, also a written statement of the applicant's circumstances as regards means of livelihood, and a certificate in writing of the truth of the facts set forth in such statement, and of the personal probity and fitness of the applicant from some minister of the Gospel, or from two creditable householders who shall be known to the founder, or after his death to the trustees, and who shall have known such applicant for at least five years; also a certificate in writing from a duly qualified medical man (who shall be the applicant's own medical attendant, if he or she have any) of his or her incapacity for labour, and of the cause of such incapacity. If the applicant be married, the fact must be stated in the application, and the like information and certificates as before mentioned must be furnished as to the wife or husband, or satisfactory reasons assigned why the same are not furnished, which reasons must be vouched by a minister or two householders, as hereinbefore provided in regard to the applicant's own fitness.

7. Before any person shall be admitted an inmate of any of the almshouses, he or she shall sign a paper, in such form as shall be prescribed, by which he or she shall undertake to quit and give up the house to be occupied by him or her whenever required to do so by the founder or the trustees; to abide by and observe all the regulations now made or hereafter to be made in regard to the occupation of the almshouses, and the conduct of the inmates thereof.

8. In the event of any inmate of the said almshouses leaving a widow at his death, such widow shall, if she give notice in writing of her desire to continue to reside in the said almshouses, be considered an applicant, and may be nominated or elected to be an almswoman, if judged a proper object of the charity, without any further compliance with the preceding rules for application for admission.

9. Each house is to be kept clean by or at the expense of the occupant, and any damage to any of the houses, fixtures, or furniture, must be made good by the occupant, or otherwise the cost thereof will be deducted from the weekly allowance thereafter to become due to each occupant. The founder or his trustees will make a periodical inspection of the almshouses for the purpose of ascertaining that this rule is observed.

10. None of the inmates of the almshouses shall underlet the tenement assigned to him or her or any part thereof, or take any person to lodge or reside therein, without the written permission of the founder or of the trustees, or of some two of such trustees, first obtained; nor shall any such inmate take in washing, or carry on any trade or business of any kind; nor shall any of the inmates absent themselves from the almshouses for a period exceeding forty-eight hours without the like written consent, and then only for such time as shall be thereby authorized.

11. The garden in the square opposite the houses will be under the charge of the founder, and after his death of the trustees, and it will be the duty of each occupant to protect the property therein from injury. The chimneys will be swept at the expense of the founder or trustees.

12. No clothes are to be hung out to dry in front of any of the houses.

13. If any inmate of the almshouses shall at any time after his or her election marry, or wilfully disobey or infringe any of these regulations, or any of the rules of the institution, or if it shall at any time appear that any inmate, or the wife of any inmate, is guilty of insobriety, or immoral or other improper conduct, or from alteration in his or her circumstances, shall have ceased to be a proper object of such a charitable institution, the founder or the trustees will, upon proof thereof to his or their satisfaction, displace and remove any such person, and the decision of the founder or trustees shall be final on any matter arising out of or bearing upon this clause.

14. The founder during his life, and the trustees after his death, will have the power to alter, modify, add to or expunge these regulations from time to time at their discretion, in order the better to carry out the intentions of the founder and increase the utility of the charity.

Among the remaining institutions of Saltaire we can only give a line to the factory schools, situated on the west side of Victoria Road, and erected by Sir Titus Salt in 1867-68. The buildings are very elegant, in the Italian style of architecture, and provide adequate accommodation for 750 children. Almost opposite the schools is the general infirmary, where all the employés connected with the mills are treated free of cost. The baths and washhouses, situated in Caroline Street, were opened on the 16th July, 1863. They were built by Sir Titus with the object of enabling his workmen to cultivate habits of cleanliness without much difficulty or cost. The washhouses contain six washing machines, actuated by three steam engines. Each person coming to wash is provided with a rubbing and boiling tub, supplied with hot and cold water. After clothes have been washed here, they are put into a centrifugal wringing machine, and a strong current of air is passed through them, the next process being that of running them on clothes horses, worked on wheels, into a drying closet, heated with hot air, where they are prepared for folding and mangling. There are twelve baths on each side of the building, and a Turkish bath in the centre.

In the midst of all his labours for the social and domestic welfare of his employés, Sir Titus has not overlooked the interests of religion. In 1858 he erected a congregational church, marked by great beauty of design, both without and within, and for internal comfort rivalling any church in the country. The seats are all free and cushioned. A chime of six bells was placed in the tower in 1870. On the south side of the church a mausoleum for Sir Titus and his family has been erected, it contains some very fine sculpture by Adams Acton. In this mausoleum, three of the children of Sir Titus have already been interred. The Wesleyans have also a chapel in Saltaire, capable of seating 800 worshippers, built on ground gifted by Sir Titus.

The last in order of date, although not the least important of the institutions of Saltaire is the public park, presented to the inhabitants by Sir Titus, and opened on the 25th July, 1871. Extending to fourteen acres of land, the park occupies a beautiful site to the north of the town and to the west of the iron bridge spanning the Aire and the canal. Provision has been made for cricket, croquet, boating, and bathing; but no spirituous liquors are allowed to be drunk or vended.

Personal and Public.

Sir Titus is one of those who have reaped in this life the reward of their labours. Although his highest recompense will always be the consciousness of having done a great and a good work in promoting the welfare of a large number of his fellow creatures—of having

> "An eye to pity, and a hand
> Open as day to melting charity;"

and of having used his immense riches without abusing them—still, neither he nor his family can be insensible to the public appreciation of his worth and work. The distinction of a baronetcy was conferred upon him in 1869. For some time he sat as member of Parliament for Bradford, but withdrew on account of failing health in February, 1861. In 1848-9 he was mayor of Bradford, and in 1857 he was made president of the Bradford Chamber of Commerce. On the occasion of the first French Exhibition he was invested by the Emperor with the Legion of Honour, and he has received other foreign distinctions in consideration of his industrial eminence.

But perhaps the most gratifying of all the marks of approval and respect showered upon Sir Titus are those he has received from time to time at the hands of his own workpeople. On the 20th of September, 1856—the anniversary of his own birthday and of the inaugural *fête* of Saltaire—Sir Titus was presented by his own workpeople, under circumstances of great *éclat*, with a bust of himself, executed by Mr. Milnes, of London. On the occasion of this presentation, which took place at Crow Nest, the favourite seat of the hon. baronet, more than 3,000 guests were entertained by Sir Titus. From the "Bradford Observer" of the 25th September, 1856, which recorded the proceedings at great length, we gather the following interesting particulars of the feast:—

On the elevated ground on the right of the park, a stupendous marquee—in fact, it was four spacious marquees formed into one—had been erected, presenting what was an immense "dining hall" of canvas. The marquee was in the form of the letter T. Two marquees, each 66 yards long by 12 broad, were placed side by side to form the horizontal stroke, and other two each 60 yards long and 12 broad, were placed in the same manner, to form the perpendicular stroke. The area of ground enclosed amounted to more than 3,000 superficial yards, and was quite sufficient to allow of the comfortable accommodation of even 5,000 persons.

The bust presented to Sir Titus Salt on this occasion was executed in the purest Carrara marble, standing on a shaft and pedestal of Sicilian marble. At the base of the shaft various symbolical figures represent the sources of the wealth and influence of the gentleman whom the testimonial was intended to honour. The accessories to the bust are striking. The shaft on which the head rests is supported by an alpaca and an angora goat, the animals which supply the raw material of Sir Titus Salt's extensive manufactory. At their feet lies an alpaca fleece enwrapping a cornucopia, from which is pouring forth a profusion of rich and luscious fruit, and falling as it were on to the works and dwellings of Saltaire, which are brought out in relief on the base of the pedestal. The artist has made the foot of the alpaca to rest, first of all, on a wreath of olives, indicating peace, and then upon the fleece from which is springing such abundance for the enjoyment and support of employer and employed, indicating plenty.

Along with the bust, the following address was presented to Sir Titus :—

"SIR,—We, the workpeople in your employment, in presenting to you the marble bust, of which we now ask your acceptance, would briefly refer to the motives which have induced us to take this step—one which may be considered almost unprecedented in the history of manufacturers. Your workpeople have for some time back felt a strong desire to present to you in a tangible form some token of their affection and regard, not only as a tribute to the genius and enterprize, which have called forth the admiration of all well-wishers of their country, but to the high and noble spirit of philanthropy which you have always manifested, and which has been actively at work, not only in securing the happiness and prosperity of your workpeople, but in the undeviating support which you have rendered to those public institutions which are calculated to promote the present and lasting benefit of the public at large. And, when we consider that this day is the anniversary of the inauguration of the works at Saltaire, we are reminded of the results of that genius and enterprize, as manifested in the gigantic establishment you have reared. Not only has its adaptation for manufacturing purposes been considered, but you have been equally careful to secure the health and comfort of your workpeople. Well does it deserve the appellation of the 'Palace of Industry.' And, Sir, your attention has not been entirely absorbed in providing for the physical wants of your workpeople, but a higher and nobler purpose has had a share of your attention, viz., the cultivation of the mind, and though Saltaire has been so recently built, we have had a library and reading room in full operation more than twelve months, the library containing more than 1,200 volumes of well-selected works, which are enjoyed and appreciated by a great number of your workpeople.

"Sir, if we look back at the seasons of commercial depression, which have from time to time visited the West Riding, entailing heavy losses upon the manufacturers and distress and misery upon a great portion of the working population, we are not unmindful that you, Sir, have nearly counteracted the effect of such seasons of distress upon your own workpeople by your efforts to keep them fully employed : for however long the storm may have lasted, a diminution in the hours of work, and a consequent loss to the operative in wages, has never yet taken place in your establishment. We think, Sir, these are circumstances characteristic of your efforts which you may look back upon with pride and satisfaction, and which we remember with feelings of gratitude ; and the benevolent spirit which has been manifested to those who have been unfortunate, and the efforts that have been made to render at all times your workpeople happy and contented have given rise to feelings of affection and love which will be lasting as our lives, and have laid upon us a debt of gratitude which cannot be repaid. But, Sir, we beg that you will accept the testimonial we offer, not for its pecuniary worth or artistic merit, but as a tribute of our affection and love.

"In conclusion, we would say that it is our sincere desire that you may live long to look with pleasure and satisfaction upon the testimonial we offer ; that your future course, and that of your sons, may be characterized by the same prosperity which has hitherto marked your career ; and that when age compels you to retire from active life, it may be a source of happiness to you to recollect that you have lived in the affections of your workpeople."

Another interesting presentation—consisting ot his portrait painted by J. P. Knight, R.A., and an album containing the names of 2,696 subscribers, mostly his own *employés*—was made to Sir Titus on the 26th August, 1871. The portrait is now hung in the reading-room of the Saltaire Club and Institute.

It is customary to close a record of the life and labours of one who has lived so well and laboured so much as Sir Titus by a glowing panegyric. But in his case eulogium would not only be uncalled for, but in bad taste. His works reflect his character ; his labours are the truest index of his worth. Few men have been able to accumulate such wealth ; fewer still have applied their wealth to such good purpose. His benefactions do not extend merely to Saltaire, where he

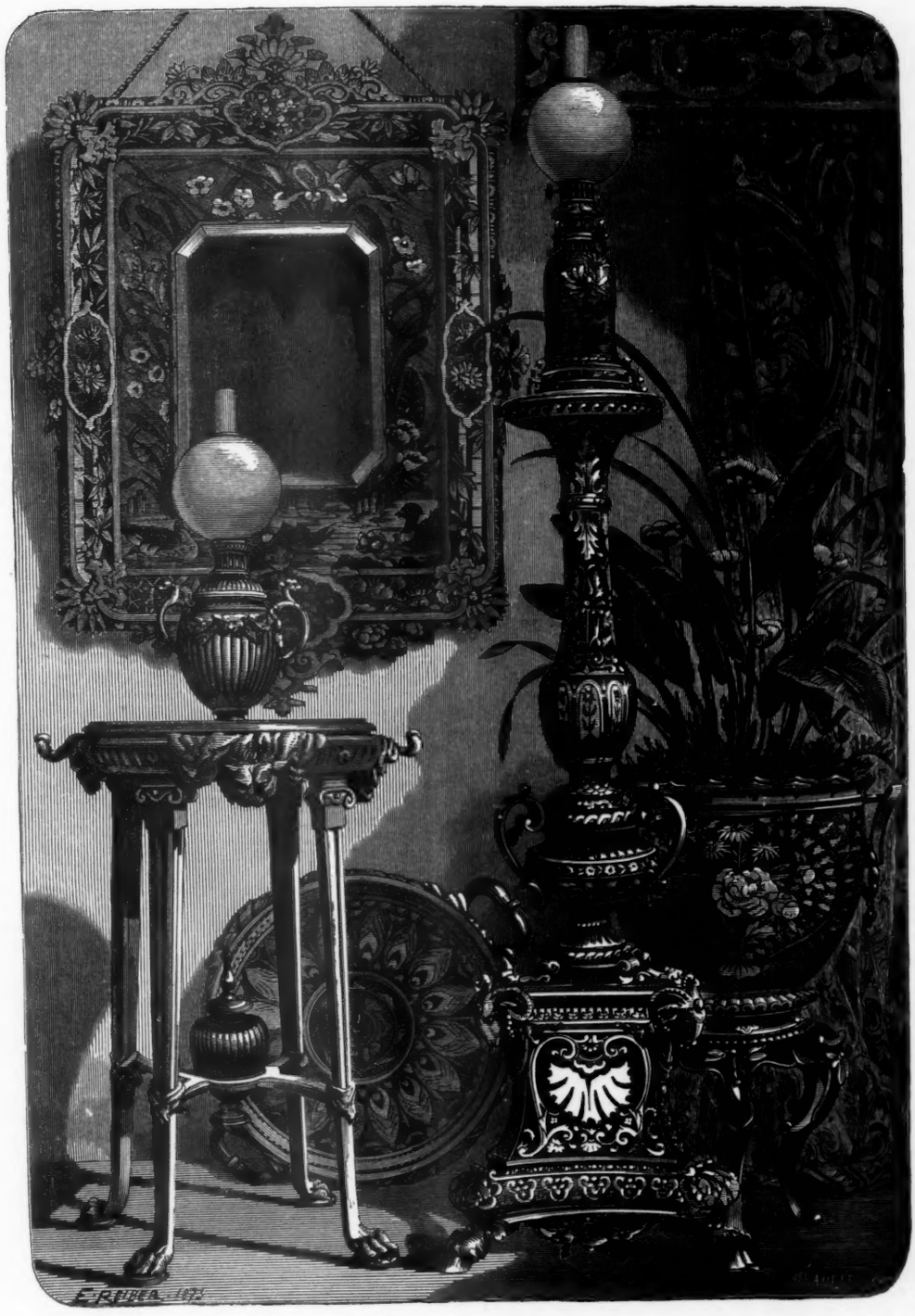
"in our wonder and astonishment
Hath built himself a live-long monument ;"

but have taken a much wider range. Gifts of £5,000 to the Bradford Fever Hospital ; of £5,000 to the Lancaster Lunatic Asylum ; of £1,000 to the Peel Park, Bradford ; and of a wing to the Hull Orphan Asylum, are but a few of many other displays of his munificence outside Saltaire. Of Saltaire itself we may truly say that it is a finished town, and that Sir Titus has, after twenty years of labour, completed his work. All the interests of its inhabitants are cared for as they are cared for nowhere else. No other town can furnish or lay claim to a similar conjunction of advantages. There may be towns with larger and finer schools, with a more extensive park, with cheaper or better houses, with equal educational resources,with the same provision for the poor, with the same sanitary conveniences ; but of no other town, we dare venture to say, can it be predicated that it enjoys all these and collateral advantages to the same extent ; and this is just another way of declaring that in no other town is the average intelligence of the people so high, in no other town is there so little crime and poverty, in no other town is comfort, cleanliness and health enjoyed and practised in the same degree. The moral of our story is obvious. How much better would this England of ours become if large employers of labour recognized their responsibilities towards their fellow men in the manner of Sir Titus Salt, and acted up to the measure of their ability !

THE JUTE AND WHALE-OIL TRADES OF DUNDEE.

THE history of manufacturing enterprise furnishes many instructive examples of the mutual relation between different branches of industry, the interaction and reaction, the incentives rendered by one to another, the evidence afforded that trade and invention, like magnets, "gain strength in giving." The discovery that palm-oil may be adopted as a useful substitute for tallow in making soap and candles has led to greatly improved processes in the palm-oil plantations of Africa, and to a lessening of the hideous slave-trade in those districts ; the discovery that beautiful colours may be obtained from fœtid and unsightly gas-tar has developed skilful processes for treating a refuse which used to be an annoyance instead of a source of profit ; the discoveries in photography have led to such improvements and such extensions in the manufacture of collodion, metallic salts, chemical apparatus, and optical cameras as were never before known ; the discoveries in electro-metallurgy have led to the development of so many novel and useful modes of covering cheap metals with thin layers ot metal more costly, that wholly new branches of industry have thereby sprang up ; the discovery by Mr. Bessemer that good steel may be made from crude iron in an expeditious way has encouraged the use of steel for a multitude of articles until recently made of iron—stronger, lighter, and cheaper in the end. And so it is in all directions. No workers in the human hive can isolate themselves from the others ; they give and take, help and aid, whether at the time they know it or not. This is true, whether we speak of *discoveries* or of *inventions*—the one the development of scientific principles not before known, the other the application of science in practical ways not before adopted—a distinction not always sufficiently borne in mind.

Something of this kind is occurring in two branches of enterprise which seem at first sight to be totally unconnected : viz. the *Whale Fishery* and the *Jute Manufacture;* and Dundee has had the good fortune to establish itself as the head quarters of both. The whale fishery had declined very much, owing to the influence of new modes of lighting in lessening the demand for lamp-oil ; but it has been found that whale oil is a useful lubricant for jute fibre ; and the wonderful advance in the one trade has to a considerable extent resuscitated the other, under improved arrangements in regard to the employment of steam power. Without going into all the factory details, we may so



GEMS OF THE VIENNA EXHIBITION.—INLAID BRONZES AND CLOISONNÉ ENAMELS EXHIBITED BY MESSRS. CHRISTOFLE AND CO.

far notice the jute manufacture as to show the relation which it bears to other branches of textile industry; and then give an outline of the whale fishery in its present improved organization.

The Dundee Jute Manufacture.

Dundee has long been one of the headquarters for the linen and canvas trades, or (more generally) flax and hemp trades. Shirtings, sheetings, damasks, duck, osnaburghs, padding, sail-cloth, floor-cloth, canvas, hessians, sacking, bags, bagging, hop pocketing, carpeting with linen backs—these are some of the many kinds of textile goods made at Dundee. In former times flax was the chief material; some of the goods were hemp, some flax and hemp, some flax and cotton. But a new member of the family has come in with giant strides, and now fairly eclipses flax and hemp combined. Jute, a fibre growing abundantly in the East Indies, was first imported into England about 1796—just a few bales. The flax manufacturers did not like it, because they did not understand it, and refused to use it. Another attempt was made a few years afterwards, and another failure; the jute was pronounced to be difficult to bleach. The first successful attempt was made about 1830 by Messrs. Cox, at the Camperdown Works, near Dundee, at the present time one of the largest linen factories in the kingdom. They began to use a little jute with the flax, then increased the preparation, and at length made nearly the whole of their textile fabrics of jute. Every process, from the perparing, spinning, bleaching, and dyeing, to the weaving, printing, calendering, and packing, is conducted within the precincts of one very large establishment.

Jute, fortunately for the Hindoo peasant cultivators of Bengal, is cultivated easily and grows rapidly; and Great Britain is ready to purchase all that India can spare. The crop, when ripe, is cut down close to the roots, and steeped or retted in water for a week or two. This retting loosens the outer fibres from the inner boon, and facilitates their separation. Flax, hemp, and jute are alike in this respect, differing in degree rather than in principle. The silky fibre is detached, cleaned, and assorted. Immense quantities are spun and woven into canvas in India, to make the *gunny cloth* and *gunny bags* in which cotton, sugar, rice, and other kinds of produce are packed. The Americans use this gunny cloth almost exclusively for cotton bale material; it crosses the Indian Ocean and the Atlantic in the form of pieces about thirty yards long, weighing 6 lb. each. As it takes about six yards for wrapping one bale of cotton, a crop of 3,000,000 bales would require 18,000,000 yards of gunny cloth. In some years India has sold nearly 300,000 tons of jute bags and bagging to various countries. The jute consigned to Great Britain is packed in bales of about 300 lb. each. The fibre is brought from the fields to Calcutta in bundles, where it is sold by jute brokers, who act for the growers on the one hand and the merchants on the other; it is sent to large packing establishments, where it is inspected, sorted, marked, and packed, 340 lb. of bundle-jute becoming lessened to 300 lb. of bale-jute, by waste, refuse, &c. It used to be treated on ship-board as a light bulky material, useful in trimming or balancing the vessel; and it was mostly brought to London or to Liverpool. A great change has taken place in this matter. Not only have Dundee firms obtained complete mastery over the manufacture, but they have built ships expressly to go out to Calcutta for cargoes of jute. They now, in the most skilful way, make use of the Suez Canal; for they have built swift steamers, narrow enough and shallow enough to navigate the Canal safely, and yet strong enough to brave the Atlantic, the Mediterranean, the Red Sea, the Indian Ocean, and the Bay of Bengal. The ship that takes in its jute cargo at Calcutta and delivers it at Dundee, without delay or transhipment, saves some thousands of miles of voyaging by going through the Suez Canal instead of round the Cape.

Let us suppose bales of jute fibre to be ready for manufacture in one of the great establishments at Dundee. When attempts were first made in this country, the dryness of the fibre baffled the workers; it would neither spin nor weave readily. At length it was discovered that whale oil is a capital lubricant for the fibres, rendering them so supple as to yield in an admirable way to the requirements of the spindle and the shuttle. No small share in the wonderful development of the jute manufacture, and the consequent recent revival of the whale fishery, is due to this simple discovery.

The first process, after the bales are opened, is *batching*. The jute, spread in layers along one side of the batching room, is sprinkled with oil and water, and so left for two or more days according to the state of the weather. When sufficiently softened by this lubricant, the batch is taken to the *breaking machine*, where it is torn fibre from fibre by the action of toothed rollers working against a larger cylinder, the jute being between them; the teeth strike the jute, and separate it into slivers or ribbons. (The individual fibres are originally from five to eight feet in length, occasionally more.) From the *breaker machine* the jute passes to the *finisher card* or *carding machine*, which acts in a similar way, but with teeth finer and more closely set. Next comes into operation the *drawing frame*, in which several jute slivers are drawn out repeatedly, increasing the length and lessening the thickness of each; and a *second drawing frame* carries this process one stage farther. The slivers or drawings are received in revolving cans, from which they pass to the *roving frame;* this apparatus gives a slight twist to every sliver, and winds it upon wooden bobbins. The *spinning frame* at length brings the jute into the state of yarn—warp for the long threads of woven goods, weft for the short or cross threads; it is something like the throstle machine used in cotton spinning, the spindles making 3,000 to 4,000 revolutions per minute.

The jute being thus spun into yarn, we have now to trace it rapidly through later processes. The *winding machine* transfers the spun yarn from the spindles to large bobbins; the *beaming machine* transfers the warp yarn to the beams which are to be adjusted in the looms; while the *pirning machine* winds the weft yarn on the pirns of the shuttles. These shuttles are larger and stronger than those used in the cotton manufacture. The *looms* for weaving are provided with a contrivance for making a proper shed or opening to receive the large shuttles. The looms themselves, if for weaving sacking, bagging, and other coarse goods, are heavier and more massive than calico looms. Jute carpeting, largely made in Dundee, have two or more shuttles, for throwing variously coloured wefts. In Messrs. Cox's extensive establishment (which Mr. Bremner described a few years ago), there were upwards of seven hundred power looms employed in weaving sackings and various other kinds of jute goods; while three hundred hand looms were engaged in carpet weaving. Jute carpeting is now an article very largely manufactured; it takes dyes easily and brilliantly, and is much more durable than any woollen carpeting that can be sold at the same low price.

Great variety is shown in the operations of the principal Dundee firms, of which Messrs. Baxter are the head, some employing from 4,000 to 5,000 hands, work up jute alone; other firms still direct their attention to flax alone; but the greater number use flax as well as jute, combined with hemp and cotton in almost infinite diversity. This is, in fact, the main feature of the trade in its present high stage of development. The mixed fabrics of Dundee (rarely, if ever, containing any wool) are only a little less varied than those of the West Riding of Yorkshire (in which wool shoddy, if not new wool, is always a component element.) As many as 500 kinds of textile material are made from various combinations of the four sorts of fibre above-named, jute being seldom omitted except in the finer varieties of linen, damask, &c. Jute does not bleach perfectly without injuring the fibre; and hence most of the goods present a rich creamy white tint, not a pure white.

Jute made but little way in Great Britain, even after its definite establishment about the year 1830. In 1836 the imports amounted only to 300 tons; by 1846 they had risen to 9,000, and by 1856 to 31,000; while the year 1866 exhibited an importation of 65,000 tons, or 500,000 bales. So far as concerns Dundee and its neighbourhood, jute overtook and overpassed flax about the year last named, and has ever since been the main staple of the place. About four years ago the Dundee district employed in these textile manufactures steam engines to the extent of 12,000 horse-power, 400,000 spindles, and more than 60,000 hands; a sum of £6,000,000 was invested in sunk capital, and £3,000,000 in floating capital. How far that which was in an infantile state in 1830 has grown to a majestic magnitude at the present time may be gathered from the following official statistics relating to the year 1873. The jute imported in that year amounted to 4,643,438 cwt., having a value of £3,634,577. (It is one among many defects in the commercial statistics compiled by or for the Government, that jute is computed sometimes in bales, sometimes in pounds, on other occasions in hundredweights, and in others again in tons; the quantity here entered is equivalent to 181,728 tons, nearly threefold as great a weight as was imported seven years ago). About six-sevenths of the jute were worked up into yarns, &c., in this country; the remaining seventh (649,232 cwt.) being re-exported for the use of foreign manufacturers. Of the finished goods exported, after supplying home wants, one entry, relating to "bags and sacks for packing merchandise," probably concerns the use of jute more extensively than of any other fibre; it amounted to the enormous number of 4,419,368 *dozens* of empty sacks and bags, valued at £1,914,418. Jute yarn, ready for the use of foreign weavers, was exported to the extent of 12,278,082 lbs., having a value of £206,525. Of woven goods, entered as wholly of jute, 96,539,763

yards, having a value of £1,591,581, were exported in the same year. This, however, was not all. A value of more than £7,000,000 was exported under the designation of linen manufactures, in the forms of piece goods, sails and sailcloth, and sewing thread; it is certain that jute was used largely in many of these goods, although we are not afforded the means of learning how largely.

Such is the development of one of the youngest of our manufactures.

The Dundee Whaling Fleet.

From jute to oil seems a strange transition; but the dryness of the one, compared with the lubricating qualities of the other, is the very fact that brings them together, and renders both of them objects of interest to commercial firms. We have explained that whale oil is an excellent emollient for the fibres of jute, in the preparatory operation of "batching;" and it may be easily understood that the batching of four or five hundred million pounds of jute in a year leads to a large demand for the oil, giving a lively awakening to a trade which had become very dormant. So little is popularly known about the whale fishery that the reader will not be sorry to have some authentic details concerning it; and these we are fortunately enabled to give by the aid of the best work on the subject that has appeared since the days of the Scoresbys. This work is Markham's "Whaling Cruise to Baffin's Bay." Captain Markham, a gallant officer in the royal navy, went out in a Dundee whaling ship in 1873, not in the course of duty, but to witness for himself the whole exciting scene of whale searching and whale chasing, whale catching and whale cutting up. It is a brisk life while it lasts, and Captain Markham has handled it briskly. One feels a satisfaction in learning that immediately on his return, he was placed in command of Her Majesty's superb ironclad "Sultan."

As may naturally be supposed, the native tribes of the shores bordering on the Arctic Seas appreciated the value of the whale long before the more civilized nations found their way into those regions. The wants of the simple Esquimaux are few, and the whale supplies many of them. The flesh is a favourite article of food with them; the oil serves as an ingredient in food, and as a fuel for light and heat; the bones, and the baleen or whalebone, are made available in the construction of tents, sledges, boats, harpoons, and spears; the sinews are employed as a substitute for thread and twine; while the thinner membranes, being translucent or semi-transparent, are made to do duty as glass for windows. How long ago the Esquimaux began to fish for whales is a problem not to be solved, simply because we do not know how long the Esquimaux have existed as an Arctic people. The Norwegians found their way to Greenland about a thousand years ago, after the whales had disappeared from the German Ocean and the English Channel. At various later dates the French, Spaniards, Flemings, Dutch, Danes, and Hamburgers embarked in the Greenland whale fishing; the Dutch were energetic in the matter, and for a long series of years furnished most of the states of Europe with whale oil.

The connexion of England, or rather of Great Britain, with the Northern Whale Fishery extends over a period of two centuries and a half. From first to last the whaling captains and crew have been admirable aiders and abettors of the Arctic explorers; and the niche of fame includes the names of many of those who have done something towards the discovery of the North-West Passage. Commercial enterprize, however, was their main purpose; and in that light only do we notice them here. Until the beginning of the present century the seas around the desolate island of Spitzbergen were their only fishing ground; but Baffin's Bay, opening into the Atlantic through Davis's Strait, and separating Greenland from America, was gradually found to be more frequented by whales, and was on this account favoured by the whalers. During a period of many years the British Government, in order to encourage the whale-oil trade, offered a bonus or bounty of thirty shillings per ton register for every ship engaged therein, and afterwards raised it to forty; but when these enterprizes became profitable, artificial stimulus was no longer needed. In the early years of the present century more than a hundred whaling ships were wont to set out annually from London, Hull, Whitby, Leith, Dundee, Aberdeen, Peterhead, Liverpool, and other ports; and by 1815, when England supplied most parts of Europe with lamp-oil, the whaling fleet reached 160 vessels. They were small, and as no coals were wanted for steaming, a cargo of forty or fifty tons of oil paid the expenses of the year's proceedings, and left a good return for all concerned. After the general introduction of gas lighting the demand for lamp-oil decreased, and the whale fishery was conducted on a less extensive scale. Some years are historically famous in connexion with disasters to the whalers. Such a year was 1830, when no fewer than twenty whaling ships were lost. The "Prince of Wales" and the "Letitia" were destroyed by sharp masses of ice passing completely through their broadsides, and literally cutting them longitudinally in two. The "Resolution" had the whole of her counter pierced, and instantly sank. The "Laurel" and the "Hope" were squeezed perfectly flat, and then thrown violently on their broadsides. The "Commodore" was lifted bodily on the ice with a twisted stern-post, and sank directly the pack ice loosened. The "Progress" was destroyed by an iceberg. The "Baffin," "Achilles," "Ville de Dieppe," and "Rattler" were crushed to pieces. Others were destroyed in various ways. On the other hand, some years have been famous for the good luck of the whalers, all returning safely with valuable cargoes. In the old sailing days a whaler of Peterhead was credited with bringing home the best cargo until that time known—blubber enough to yield 300 tons of oil, worth £9,500, besides whalebone; this was in 1814.

Steam power was gradually adopted in whaling ships, not so much for a quick passage as for the advantage of having a propelling force strong enough to force the ship through or between masses of floating ice. If the whalers in 1830 had had steam power, many of the ships might have been saved. The vessels now engaged, under the impetus of a revived demand for whale oil, are strongly built, doubly fortified with wood and iron inside and out. Great importance is attached to a ramming power, a strong mass of angle-iron at the stem, to cut through the ice. Owing to the expense of coals and the high prices of labour and materials, a larger cargo is required than in the old days to render a voyage remunerative; unless a ship brings home seventy or eighty tons of oil, neither owners nor whalesmen are satisfied. England has now abandoned the trade altogether, and Scotland absorbed it; all the whalers hail from Dundee or from Peterhead, chiefly the former. They generally leave port about the beginning of May, cruise about near Frobisher Strait, and then pass up into Baffin's Bay; in June and July they fish in Lancaster Sound, in August and September in and about Prince Regent's Inlet; when bad weather sets in, they turn their prows homeward, and get back to port in October or November. If their fishing is more than usually successful, they may reach port in August or September. On an average, they are afloat about five months. The Dundee whaling fleet for 1873 comprised the following vessels, all steamers. The chief owners are the Dundee Company; the next the Tay Company; the others have one ship each:—

	Owners.	Tons.	Horse Power.	Length. Feet.	Breadth. Feet.
Arctic	Stephens and Co.	439	70	157	30
Eric	Gibbs and Sons	412	70	155	30
Ravenscraig	Lockhart	394	60	130	30
Tay	Arctic Company	360	60	132	26
Esquimaux	Dundee Company	436	70	157	30
Camperdown	„	424	70	150	30
Narwhal	„	434	60	150	30
Polynia	„	358	60	146	29
Intrepid	Tay Company	326	50	126	30
Victor	„	270	36	107	28

These ships were built at various times between 1847 and 1867. Eight of them carry eight whaling boats each; the other two carry seven each. Six were built for the trade, four were sailing vessels converted into steamers.

The captain and men are paid in a remarkable way for their services. In the first place, there is an ample supply of plain but wholesome provisions, comprising bread, flour, salt beef and pork, oatmeal, butter, cheese, tea, sugar, lemonade, water, &c. In the second place, there is a regular money pay per month, varying with their ranks in the ship, and reckoning for the whole time of the voyage. And in the third place, there is an allowance for every ton of oil brought home and every ton of the valuable commodity whalebone, the one known as "oil money" and the other as "bone money." This is found to be an excellent arrangement, seeing that the men are incited to do their best by the certainty that an increase of capture will be followed by an increase of emolument. In the largest and best ships the hands are fifty-four in number, all told. Their designations, pay, proportions of oil money, and proportions of bone money are as follows:—

	Monthly pay. £ s. d.	Oil money. Per ton. £ s. d.	Bone money. Per ton. £ s. d.
Captain	8 0 0	2 0 0	7 0 0
Mate	5 0 0	0 7 3	0 10 6
Second mate	3 15 0	0 7 0	0 10 6
Surgeon	2 0 0	0 2 0	0 2 0
Specksioner	2 15 0	0 7 9	0 10 6
Engineer	7 0 0	0 7 3	0 10 6
Second engineer	3 5 0	0 3 6	0 10 6
Carpenter	3 10 0	0 3 6	0 6 0
„ mate	2 15 0	0 2 6	0 4 0

	Monthly pay.			Oil money. Per ton.			Bone money. Per ton.		
	£	s.	d.	£	s.	d.	£	s.	d.
Harpooners (2) . .	2	15	0	0	6	9	0	10	6
Loose harpooners (2)	3	5	0	0	3	6	0	10	6
Cooper . . .	3	10	0	0	6	9	0	10	6
Shipkeeper . . .	2	10	0	0	6	9	0	10	6
Boatswain . . .	3	0	0	0	2	6	0	5	0
Skeeman . . .	3	0	0	0	2	6	0	5	0
Boat steerers (2) . .	3	0	0	0	2	6	0	5	0
Line managers (8) .	2	5	0	0	2	0	0	4	0
Cook	2	10	0	0	2	0	0	2	0
„ mate . . .	1	15	0	0	1	6	0	2	0
Steward . . .	3	5	0	0	2	6	0	6	0
Firemen (3) . .	2	15	0	0	2	6	0	6	0
A B seamen (10) . .	2	0	0	0	1	9	0	2	0
Ordinary seamen (5) .	1	10	0	0	1	6	0	2	0
Boys (3) . . .	1	0	0	0	1	3	0	2	0

The captain's oil money is only £1 4s. per ton up to 100 tons, after which it is £2. The mate, second mate, specksioner, and cooper act as assistant harpooners, and the boatswain and skeeman as assistant boat steerers, in addition to their other duties. The higher pay of the engineer than of the surgeon may probably be explained by the fact that engineers, having good wages on shore, would not embark unless paid well; whereas young surgeons are plentiful in the market, and are willing to accept situations at low salaries until they can establish private practice at home. The specksioner superintends the cutting up of the whales; the skeeman superintends the stowing away of the blubber between decks and in the hold; the loose harpooner is a kind of second or helper to the skilled harpooners. When on board ship, before the men go off to attack the whales, the mates and specksioner take charge of the watch, the harpooners aid at the helm, the boatsteerers man the forecastle, the line managers arrange the whale lines near the mainmast, the boatswain superintends all the work aloft, and the skeeman everything between decks and in the hold.

A "payable fish" is a whale which has whalebone six feet or more in length, this being a technical mode of estimating the general size and value of the animal. There is an extra bounty to the crew of the boat that first strikes a whale, provided the latter be captured and "payable;" this is called "fast money." The captain has also £1 to £7 "striking" money. We may here remark that whalesmen, like other hard workers, know how to hold out for higher pay when they think that circumstances warrant it. In 1868 there was a large meeting of mates, harpooners, and others at Dundee, to take into consideration a project announced by the companies of lowering the monthly pay and the oil money, and to stop the fast money altogether. Into the details of the matter we need not enter; suffice it to say that the whalesmen did not ask for any additional emolument; they only stood out for the rates which had been customary.

The Capture and Cutting-up of Whales.

Concerning the remarkable operations in the actual fishing, we cannot do better than follow the footsteps of Captain Markham, and touch rapidly on matters which he treats in full detail. His descriptions are vivid as well as accurate, alike readable and reliable.

As a naval officer on half-pay, desirous of witnessing for himself some of the physical characteristics of the Arctic Regions, Captain Markham went out as a volunteer whalesman. Whaleships not being licensed to carry passengers, he signed articles as one of the crew, by friendly arrangement with the owners of the vessel. He bound himself to obey the captain, and to make himself generally useful; he was to receive an amusingly small share of monthly pay, oil money, and bone money, merely to make the contract technically complete; but he was practically made as free and as comfortable as circumstances would permit. As to rations, all shared pretty much alike, plenty but homely. In May, 1873, the good ship "Arctic" started from Dundee, with Captain Markham as volunteer, and Mr. Adams as captain or master. Passing through the Pentland Firth, and across the North Atlantic to Davis's Strait, the "Arctic" reached the whaling region, and prepared for those boat adventures which constitute the most exciting part of the fishery.

Let us suppose that the crew espy a whale. All is instant activity on board. The boats, seven or eight in number (eight for a full-sized ship), are strong carvel-built craft, from 24 ft. to 28 ft. long; each capable of carrying six men and seven or eight cwts. of stores and fittings. All the boats are so suspended that they can be lowered very quickly; and the stores carried by each are so packed as to occupy the smallest possible space, and so located as to be handled just in the order in which they are wanted. Each boat is manned by six hands; viz., one to steer with the oar (there is no rudder to whale boats), one harpooner to take the bow oar and to manage the boat, one to take the stroke oar and to manage the line, and three to take the intermediate oars. The lines have been attached to the harpoons before being stowed in the boats; these harpoons are of two kinds, the *hand*-harpoon to be thrown, the *gun*-harpoon to be fired off. Each boat carries five whale lines, each line measuring 120 fathoms; the lines are half-inch hempen rope, of the best quality and well tarred. Compartments in the boat are filled up with fore-gores, whale lines and stray lines, protected from the weather by canvas aprons. The harpoons are made of soft Swedish iron, to bend rather than break; they are about five feet in length, with a flattened point having sharp-cutting edges, and two flattened barbs; they are made, with cruel ingenuity, to stick into the soft body of the poor victim as resistlessly as possible. The gun-harpoon is a short iron bar with a barbed spear at one end, and a ring and chain for attaching it to the line; it is fired from a small swivel cannon fixed to the bow of the boat. Lances are also used, with blades five or six inches long by three inches broad, provided with sharp cutting edges, and fitted to the end of long wooden handles. Chemists have devised scientific modes of expediting the killing of the whales, by enclosing tubes, containing prussic acid or strychnine, in the head of the harpoon, and thus poisoning the animal outright; but whalesmen dislike the novelty, and seldom adopt it. Among other stores of the boat are tow-ropes, oars, lances, tail-knife, hand harpoon rests, snow shovels, buckets, extra thole-pins, marlin-spikes, splicing fids, a fog-horn, files, boat-hooks, balls of spare yarn, boxes of ammunition, &c. A flagstaff and a jack are provided, to hoist as a signal when a whale is struck; and occasionally a mast and sail. No provisions are taken, as the men are too busy to spare time for eating during the hours (few or many) until they return to the ship. The captain, surgeon, engineer, shipkeeper, cook, and steward remain on board, watching the progress of the boats, and ready to steam about in case of disaster to any of them. Flag signals enable the captain to trace the course of proceedings and to give directions to the crews of the several boats.

The chase of a whale is intensely exciting, and not free from peril. The boats are rowed as near the monster as may be, and then harpoons are thrown or fired into his soft oleaginous body. Away he starts with tremendous velocity, dragging the lines to which the harpoons are attached. If any one of them does not uncoil freely, it is instantly cut and sacrificed, else the boat and its crew would at once be dragged under water. Even with the readiest uncoiling the boat is often dragged along a considerable distance. The first whale hooked by the men of the "Arctic," in the voyage of 1873, dragged out upwards of a mile and a quarter of line, and literally pulled the boat along; when half of it was hauled in it snapped, and the whale went off with the other half, after four hours' hard work. On one occasion the "Arctic" came up with a large female whale and its sucker or young one, with two harpoons in its body; the mother started off at a terrific rate, and dragged two boats at least five knots an hour; the line was pulled with such force as to set the edge of the boats smoking with the heat of friction. When seven harpoons, several lances, and a rocket had been lodged in the body of the victim the ship steamed up to the boats and helped to draw in one of the lines. The whale actually dragged the ship as well as the boats along, and Captain Markham pictures the scene thus: "I can safely say, if any one asks me how I went to Barrow Straits, that I was towed there by a whale." Often the boats go out time after time before a whale can be hit; and even then the leviathan may escape, taking a long length of valuable rope with him.

We will suppose a whale to be pierced with half a dozen or more harpoons, and to have yielded to his fate by resigning the struggle—probably only with his life. The animal turns over on his back, and so floats along. The boatmen assemble around him, and cut a hole through each fin; lines are inserted in the holes, and lashed round the body of the whale, to facilitate towing; the tail is raised up near one of the boats, and all the oarsmen pull away. The fish (for although whales are not included by naturalists among fishes, the whalesmen employ this designation) is brought up to the ship-side tail foremost; it is secured to the fore-rigging by tackle from the tail, and to the aft-rigging by tackle from the head and body; while heavy purchase from the mainmast affords the means of turning the ponderous mass over and over when required. All being ready, and the men primed with grog, they set about the work of *flensing* or *flinching;* that is, removing the blubber from the skeleton. This blubber is the fat substance which contains the oil; it is a kind of open network of fibres, filled in with fat. It is not the real flesh of the whale, which is red, firm, and coarse; but a layer, from one to two feet in thickness, interposed between it and the smooth oily skin. Whatever its other purposes may be, it constitutes a warm great coat for the whale. The captain and mate, up aloft, keep a watch on the operations of the flensers, and direct the

movements. The men have iron spikes in their boots, to enable them to stand on the oily body of the whale without slipping off. With blubber-spears, shaped something like hoes, they cut off the belly blubber and the right fin; then turn over the mass, and similarly remove the back blubber and the left fin. The blubber, in masses weighing from one to two tons each, is hauled up by tackle. The whalebone is detached, then the lips, then the tail; all the rest, called *kreng*, is allowed to float away or to sink as it will. The tongue is a soft thick mass, containing some oil; the head occupies from one-fourth to one-third of the whole length of the animal; the tail (in a full-sized whale) is five or six feet long, by twenty or twenty-five feet broad; the fins or flippers are each eight or nine feet long by four or five broad. When the whale is only of small dimensions it is flensed so as to be hauled up in four portions—first, the under jaw and the tongue; then the upper jaw, whalebone, and remainder of the head; next, one fin, with all the blubber from the belly and one side; lastly, the other fin, the tail, and the blubber from the back and the other side.

It is necessary here to mention that whalebone, one of the valuable products for which the whale is sought and captured, is not the real bone of the animal, but a remarkable apparatus to which there is hardly anything else similar among the denizens of the deep. Within the whale's mouth are plates of whalebone, several hundred in number, and packed very close together; the whole amounting, in a large whale, to one and a half or two tons in weight. They are suspended from the roof of the mouth, and extend on each side from the middle line of the palate, like the barbs of a feather; those in the middle of the mouth being the longest. The edge of each plate forms a loose fringe, composed of fibres or pliant bristles. The use of this whalebone, in the daily economy of the animal, is very singular. When the whale opens his mouth, while swimming in the ocean, water enters; and the small animals which enter with it being retained as food, the water flows out again. It is nature's original for the sluice at the Old Eel Pie House, in the bygone days of Sir Hugh Myddelton's New River.

Let us return to the operations of the flensers and their companions. When the cubical masses of blubber have been hauled up into the ship they are cut into smaller cubes, seized with pickiesor pick-hacks, and stowed temporarily between decks. The whalebone is split into portions of nine to sixteen blades each, by means of large iron wedges; and these into smaller portions of three or four blades. The tail is cut up into blocks, useful as chopping blocks in subsequent operations.

All this is very exciting, from the time the attack on a whale first commences until the blubber is cut up ready for stowing. Captain Markham amusingly describes the kind of life:—"The state of irregularity in which we live is positively delicious. I never know when I am to have anything to eat, nor even when I am to get my sleep. On some days we breakfast at 5 A.M., on others at 5 P.M.; and the remaining meals are obtained in the same charming proportions of irregularity." As the whale fishing is conducted in the summer months in a high northern latitude, there is no real night, and this tends still further to dissipate the idea of regular meal-times. The decks get into an indescribably filthy state, with a mixture of coal-dust and blubber-grease; for the blubber-tanks are used as coal bunkers on the outward voyage, and require to be emptied and cleansed on deck to fit them for their main purpose.

On the first fine day, when no other whales tempt the whalesmen out, the blubber is stored in the hold. The large lumps are dragged to the sides of the deck with pickies, and cut up into pieces of twelve or fifteen pounds each; bits of kreng and offal are removed, and the pieces are thrown forward to other men, who cut off the skin with sharp tools; the pieces are then passed down through the hatchways, and by means of hose or canvas pipes descend into the tanks. The tail is chopped into small pieces, and similarly tanked. The skin is usually thrown away; but Captain Markham induced the captain to reserve it as a present for the Esquimaux servants at Disco, a Danish settlement on the Greenland coast; they welcome it as an article of food and an anti-scorbutic medicine.

It was the good fortune of the "Arctic" in 1873 to bring home the best cargo ever known from Baffin's Bay. The following table is instructive, as showing (1) the number of days on which whales were captured; (2) the sex; (3) the lengths of whalebone blades; (4) the weights of whalebone; (5) the weights of oil; and (6) the approximate value:—

	Sex.	Whalebone. Length. ft.	in.	Weight. cwt.	Weight of Oil. tons.	Approximate Value. £
May 23 . .	M.	9	7	14	13	900
June 15 . .	F.	5	4	2½	3½	222
„ „ . .	M.	5	6	2½	3½	220
„ „ . .	F.	3	5	2	2	130
June 15 . .	M.	7	0	4	5½	339
„ 19 . .	F.	11	7	25	19	1450
„ 23 . .	F.	8	6	11	11½	770
„ „ . .	M.	7	0	5	6	380
„ 24 . .	F.	10	4	19	11	950
„ 25 . .	M.	8	10	12	10	740
„ 28 . .	F.	9	2	13	12	850
„ 30 . .	F.	6	5	4	5	315
„ „ . .	F.	10	4	20	20	1360
„ „ . .	M.	2	6	1	2	110
„ „ . .	M.	4	0	2½	3½	238
July 5 . .	F.	11	9	25	20	150
„ „ . .	M.	6	6	5	7	420
„ „ . .	F.	2	6	1½	4	200
„ „ . .	M.	2	6	1½	3	160
„ 6 . .	F.	7	0	7	8	520
„ 9 . .	M.	10	6	22	18	1300
„ 10 . .	M.	11	0	20	13	1060
„ 13 . .	M.	9	6	16	14	950
„ 20 . .	M.	5	3	2½	4	250
„ 29 . .	F.	10	0	20	14	1100
August 1 . .	M.	6	9	7	6	500
„ 9 . .	M.	8	6	12	10	740
„ 11 . .	F.	10	2	20	17	1230

The cargo, it will here be seen, was a valuable one, approaching 20,000*l.* in aggregate value. The largest whale caught yielded 25 cwt. of whalebone, and 19 tons of oil, worth together £1450; the smallest, 1 cwt. of whalebone, and 2 tons of oil, value £110. The value of the whalebone increases with the length of the blades, which varied from about 2½ to 11½ feet. The smallest were "suckers" or baby whales. The yield was nearly 300 tons of blubber, and 340 cwts. or 17 tons of whalebone. The "Arctic" also captured nineteen narwhals, twenty seals, and twelve bears—worth bringing home as small additions to the marketable store, in regard to skin, teeth, &c.

When a whaler arrives at Dundee or Peterhead, landsmen before very long extract all the oil out of the blubber, and bring the blades of whalebone into a marketable state. The captain has already formed a rough estimate of the quantity of produce obtained; but this is more accurately determined in port, as well as the market price of whale-oil and whalebone; and then the accounts can be made up, in regard to monthly pay, oil money, bone money, fast money, &c. The extraction of the oil is not an elaborate process. The blubber is removed from the ship's tanks into casks, and taken to the boil-yard; being emptied out into large coppers, having a capacity of ten tons each, it is exposed to the action of steam, which boils out the blubber from the membranous tissues. The oil, after being allowed to settle in coolers, is run off into large storing tanks, ready for delivery as required by the market demand. Seal's blubber, until recently, was stored several weeks before being boiled, in order that it might be so far decomposed as to facilitate the extraction of the oil; but the Dundee firms now have a machine which crushes the blubber at once, enabling the boiling to go on without further delay, and at the same time producing oil of a better quality. A ton of whale's blubber yields about 200 gallons of oil; seal's blubber is less productive of oil.

The whalebone or baleen is a remarkable substance, applicable to many purposes for which no other material will suit so well. The blades or plates vary from a few inches to ten or twelve feet in length, generally bluish black in colour, but sometimes striped with white longitudinally. To prepare them for the use of umbrella and parasol makers, stay makers, brush makers, &c., the blades are trimmed by removing all hairs from the point and edges, and scraping the flat surface; they are then boiled in water for several hours, until soft enough to be easily cut with a knife; they are finally cut into lengths suitable for various purposes, and split into thin and narrow strips. The blades are often dyed black while being boiled.

HINTS how to use a Grindstone.—1st. Don't waste the stone by running it in water; but if so, don't allow it to stand in water when not in use, as this will cause a soft place.

2nd. Wet the stone by dropping water on it from a pot suspended above the stone, and stop off the water when not in use.

3rd. Don't allow the stone to get out of order, but keep it perfectly round by the use of gas-pipe, or a hacker.

4th. Clean off all greasy tools before sharpening, as grease or oil destroys the grit.

5th. Observe—When you get a stone that suits your purpose, send a sample of the grit to the dealer to select by, a half ounce sample is enough, and can be sent in a letter by mail.

THE PRODUCTION OF TEA IN JAPAN.[1]

THE opening of Hiogo and Osaka to foreign trade in January, 1868, brought foreign merchants into a more intimate connection with the most important tea-producing districts of Japan, and soon resulted in a marked increase in shipments. It is true that the main bulk of exported Japanese tea goes to America, and that a large proportion of the quantity that does reach England is merely intended for transhipment; but this very fact aroused the curiosity of our own merchants, and consequently led our Government to direct the English consuls there to gather every possible information on the subject. These "Reports" have recently been collected, and form one of the most interesting "Blue Books" ever laid before Parliament. We regret that, from their nature and their bulk, it is impossible for us to lay before our readers the curious coloured drawings after a "native artist," with which the "Reports" are embellished. We can, however, address ourselves to the letterpress, and we subjoin herewith a sequential and succinct *précis* of the information and statistics conveyed.

The Japanese Government, with their usual enlightenment, were ready and willing to lend our representatives every aid in their power; but it was not the same with tea as with rice and silk, and the local authorities were completely ignorant as to the amount produced. They, however, caused inquiries to be instituted; the results were placed at the disposal of the consuls, with a warning that the statistics could not be wholly trusted, as the tea-farmers, dreading that true returns of their industry would hasten a new tax, had thrown every possible obstacle in the way.

There is no such mysterious uncertainty in regard to the cultivation of the plant, and the subsequent method of manufacture; and, both from their own knowledge and from native sources, the consuls here supply us with the most ample and accurate material.

From the researches of acting consul Enslie we are able to trace the history of the tea trade in Japan from its commencement.

It appears that tea plants have been known here ever since the cycles of Genroku and Hoyéi (170 or 180 years ago), and that about this time, while Sakakibara Shikibu Shoyu was Daimio of Takata, a place some miles off, they were used for hedges.

Some time after this one Nabeya Tonoské of Minakami first commenced to use the leaves; and as the tea he prepared, though of inferior quality, was much cheaper than that imported from the Southern provinces, a small trade sprung up with Shonai and the other north-east districts in the fragrant leaf as far back as 1720.

The principles on which this business was conducted, and which were then also adopted with many other descriptions of merchandize, were to give one year's credit. It is curious to note that this custom is still strictly adhered to by apothecaries.

Very little care and attention were, however, at that time paid to the tea plantations, which had been gradually laid out, and it is only during the last twenty years that the culture of tea in this part of Japan has increased to any great extent.

Prior to this the Echingo teas had always been prepared according to the "Chiséi," or local method, and it was only about 1855 that Nabaya Jubéi, a tea-grower of Minakami, brought one Yanada, of Uji (a place near Kiôto, celebrated for the excellence of its teas), here, and introduced an improved mode of preparing the leaf.

The local method consists in first steaming the leaves in iron pots and afterwards rolling them on mats, and then drying them on large paper drums heated by charcoal. The custom in Uji is similar in every respect, except that the tea is rolled between the hands instead of on mats, and that greater attention is paid to the first steaming.

At Nutsu and Muramatsu tea plantations have also existed for about one hundred years.

Murakami is at present the largest tea-producing district in the neighbourhood, but much attention is also at present paid at the two towns just mentioned, and another small place called Kurokawa, to its culture; and as every endeavour is being made to extend the tea plantations, the growers are confident of being able to produce very much larger crops in a couple of years.

The amount annually produced at Murakami may be roughly estimated at 200,000 lbs. (266,666 lbs. avoirdupois) to 260,000 lbs. (333,333 lbs. avoirdupois) as follows:—

1st quality—4,000 to 5,000 lbs. (5,333 to 6,666 lbs. avoirdupois).

2nd quality—50,000 to 60,000 lbs. (66,666 to 80,000 lbs. avoirdupois).

3rd quality—80,000 to 100,000 lbs. (106,666 to 133,333 lbs. avoirdupois).

4th quality—70,000 to 90,000 lbs. (93,333 to 120,000 lbs. avoirdupois).

All the teas grown in this province have a slightly harsh or bitter taste, which, although the leaf is similar in appearance to that of some kinds of southern teas, makes them of inferior quality. Murakami teas do not form an exception to this rule.

Another objection is the general want of care and attention in the manipulation of the leaves, which are frequently broken, badly rolled, and mixed up with stalks and yellow, decayed, or overdried leaves; a slight improvement was, however, visible in this respect last year.

The finer qualities are as a rule well prepared, have a dark blue, greyish appearance, draw light, and though slightly bitter they have a good and aromatic flavour.

The best kind, or first picking, is used for local consumption, and fetches a high price (3*s.* to 4*s.* per lb.); the next best, or middle-classed teas, are either sent for sale to Yokohama or Nügata, and average from £4 6*s.* 8*d.* to £11 10*s.* sterling per picul (133 lbs.) The worst quality, worth from 7 to 10 rios (£1 10*s.* 4*d.* to £2 3*s.* 4*d.* sterling) per picul, is sent to the neighbouring towns of Kashiwadzaki, Takada, Uyéda, Nagaoka, and Ujiya.

Muramitsu teas, not much sought after by the Japanese, are much preferred in the foreign market to those of Murakami, although the latter are held in higher esteem by the Japanese. The Muramitsu leaf has a fine dark-grey colour, a fragrant smell when rolled between the hands, draws a light yellow colour, and has an aromatic flavour nearly free of all bitterness; this latter, however, only as far as the best kind is concerned. The better qualities of tea in the district therefore fetch a high price, and are very well suited for the American market.

They would also meet the wants of the English market it obtainable at lower rates.

He proceeds to add many details given elsewhere, but one or two facts, not otherwise reproduced, are worthy of note.

Females are mostly employed for plucking the leaves, and men do the more arduous work of firing and sifting; women are also used for packing and sorting the tea. An expert workman can prepare from 9½ lbs. to 13½ lbs. of tea daily, for which from 46¾ lbs. to 66¾ lbs. of green leaves are required, and about 30 lbs. of charcoal used. The wages of the (male) labourers vary from 6¾*d.* to 1*s.* 1½*d.* per diem. Women, employed in picking the green leaves, receive 2¾*d.* and food for every 6¾ lbs. weight of leaves.

Sulphur and petroleum springs are found in the vicinity of many of the tea producing districts, which may account, to some extent, for the slightly unpleasant taste of Japanese tea, one of the greatest drawbacks to its European consumption. At Nütsu, especially, the ground is thoroughly impregnated with petroleum, which has a decided effect on all vegetation.

We next quote from Mr. Lawrence's report on Yamashiro, the province of Japan where the best tea is produced; it is bounded on the east by the provinces of Omi and Iga, on the north by Tamba, on the west by Setsu and Kawachi, and on the south by Yamato. It is a small province about ninety miles in length from north to south, and not more than twenty-five in breadth. The neighbouring provinces of Omi and Tamba also produce tea, and in much greater quantity; but notwithstanding the smallness of Yamashiro as compared with them, yet the value of its tea is said to be much higher on account of the superior quality of that produced at Uji, Koata, and Ogura.

Uji is a little village about eleven miles to the south-east of Kiôto on the left bank of the Ujikawa, a river which flows out of Lake Biwa about ten miles distant, and traverses the chain of mountains between the lake and the plain in which the towns of Kiôto, Fushimi, and Yodo are situated; this chain runs north and south, and the best positions for the tea plantations are the eastern and western slopes. Some of the villages, such as Gonokuchi, &c., are in valleys in the mountains, but the plantations of Uji, Koata, and Ogura are at the foot and on the slopes where there is very little water. The climate of Uji is very mild, snow is rare, and hardly ever falls more than 1 in. in depth. Last year was an exception to the rule, and in some places the young leaves were frostbitten. Plentiful rain is requisite for them. They are sometimes injured by caterpillars in the spring.

Tea is grown from the seeds, which are planted in the second month, March. No special care is necessary except manure. During the sixth and seventh months grass of all kinds from the mountains is allowed to rot round the shrubs, but if this manure

[1] *Reports on the Production of Tea in Japan.* (*Illustrated with copies of drawings by a native artist.*) *Presented to both Houses of Parliament.* Printed by Harrison and Sons, 1873. Price 4*s.* 6*d.*

only is used the tea has a bitter flavour. Fish manure is used during the eleventh month, and ordinary manure during the ninth and twelfth months. In the spring, when the shrubs are budding, they are protected for about twenty days from the heat of the sun by matting supported on poles about 8 ft. high. It is usually five years before a shrub arrives at maturity. This, however, is not a general rule, as I was shown some tea made from trees only three years old. The new leaves are plucked in the fourth month, May. The flowers are not made any use of. The first crop is called shincha. There is a second crop called nibancha, at the end of the fifth month. In the autumn, after the seeds are picked, the shrubs are pruned, and the remaining leaves are sold and made into bancha, an inferior kind of tea used by the poor. A tree is never allowed to attain more than 5 ft. in height. The older the tree the better the crop. The trees which produce the tea worth five dollars the pound in Minobei's plantation at Ogura are, he told me, from 400 to 500 years old. In these the trunks are from 5 to 6 in. in diameter. This plantation has been possessed by Minobei's family for six generations.

I inquired in the villages which I visited what amount of the land under cultivation was given over to tea. In most places, however, the tea shrubs were scattered over the farm. Occasionally a field contained nothing else; but, as a rule, there would be rows of tea shrubs 4 or 5 ft. apart, the vacant space being filled up with corn or vegetables not requiring irrigation. The hedges in the lanes and round the kitchen gardens in the villages were generally tea shrubs. In the village of Gonokuchi, the farmer told me that the extent of the whole farm was 18,000 tsubos[1] (about 15 acres), a very small proportion of which was used for cultivating tea. His farm produced 4,375 kin[2] per year, which were worth 3,500 rios (about £700).

Until the statistics shall have been procured by the Government, the calculation of the whole amount produced in Yamashiro cannot but be approximative. A merchant of Uji told me that the value was 750,000 rios (about £150,000); that it was increasing every year, and in a few years would be £200,000. The cause of this increase he attributed to foreign trade.

Kimura, the official charged with collecting information on the subject, calculated it much higher. He gave me a written statement to the effect that the amount of Yamashiro tea sent to Kiôbé and Yokohama last year was 2,500,000 kin, at prices varying between 30 and 40 rios the 100 kin (133 lbs.); or worth between £150,000 and £200,000. The amount sold in the country he calculates at 1,500,000 kin, at prices varying between 5 rios (£1) and 1¼ boo (*1s. 3d.*) the kin. Of these 1,500,000, two-thirds he states to be of the finer qualities.

According to Minobei, who owns much of the land round Ogura, the extent of ground in Yamashiro producing tea worth 5 rios the kin was 10 chôs, of which he possessed one. He stated that the green leaves plucked from one ton, or one-tenth of a chô, or one-fourth of an acre, weighed 150 kwan (1,250 lbs.), and produced 90 kin (120 lbs.) of superior, and the same amount of inferior tea. He considered the good tea in the district as worth £200,000, and the inferior, £100,000. He stated that every year the amount of land cultivated increased, but he did not expect any material increase in the amount of superior tea, as this depended on the goodness of the soil, the extent of which was very limited.

Omitting the explanatory notes to the curious drawings of the "Native Artist"—as we shall give fuller and more reliable instructions from the work of a technical Japanese authority—we learn that in the year 1871 the chief tea merchants of Kioto formed themselves into a company, at the head of which is Minobei, for the purpose of regulating the price of tea. They got over some Chinese in order to prepare tea in the Chinese fashion, and during the last six months they have sold over a million kin of this tea. They intend increasing the amount of tea so prepared. It is sold at prices varying between 10*s.* and 8*d.* the kin (1⅓ lb.)

Continuing his journey, he adds:—

On my way back from Kioto to Yedo, I crossed the provinces of Omi and Mino. The tea of the former ranks next to that of Yamashiro. It produces, I was told, three times as much, and the dearest is sold at 3 rios (12*s.*) the kin. In Tamba the dearest is 2 rios or 8*s.*, and in the other districts 2*s.* West of Yamashiro Bisen produces the best; and, after that, Sackushu.

At Omi, the different grades of tea vary from £18 the 100 kin (133 lbs.) to £12.

At Mino a great deal of tea is produced, but of very inferior quality to that of Omi. In the neighbourhood of Sckigahara it sells as low as 2*s.* the lb.

At Kioto, Minobei produces two teas, both powdered—Koicha, which is drunk thick with the powder (18*s.* to 7*s.* the kin), and Usucha, which is prepared differently, and is much thinner (rising from 5*s.* to only 12*s.*)

Another kind—the Sencha teas—are for every-day use, and vary from 5*s.* 6*d.* to 1*s.* 6*d.* the kin. The price of tea sold for exportation is from 3*s.* 4*d.* to 3*s.* 9*d.* per lb. English.

Consul Robertson's Report, containing an interesting epitome of a Japanese work on the subject, we give *in extenso*:—

The tea season, that is, the period from which the new leaves first appear in the market up to that when the annual produce is exhausted, is comprised between the months of June and February inclusive. At times, as was the case last year, 1872, the new leaf makes its appearance in the Yokohama market in May. A small business is done during February, March, April, and May, but this consists in settlements for very inferior leaf.

As is probably well known, China leaf finds its way to the hands of the foreign purchaser fully cured and packed and ready for exportation. Japan leaf, on the other hand, comes to market in a comparatively raw state, though partially sun-dried, or fired, and is then submitted to a thorough process of firing at the hands of the foreign exporter, either in his own or in another's establishment at a fixed rate of charge.

Firing may be said to consist in the application of heat with a view to the extraction of sufficient moisture from the leaf as will permit of its exportation and its arrival at the port of destination in much the same condition as it leaves this. By experiments it has been ascertained that from four to five per cent. of moisture exists in well-dried China and Japan leaf on its arrival in Europe. Assuming the amount of moisture in a leaf in its original state to be 80 per cent., from 70 to 75 per cent. has to be extracted before export.

The process of firing in Yokohama is by pans under which a charcoal fire is lit, heat derived, and the tea leaf carefully manipulated by hand. There are about fifteen tea-firing establishments in Yokohama, and these in the height of the tea season give employment to some 1,800 or 2,000 hands (mostly women and children). The rate of wage is about 17 tempos, equal to 18 cents. Mexican, at exchange of 4*s.* 6*d.*, say 9½*d.* per diem, the working day commencing at 7 A.M., and closing at 5 P.M.; overtime meets, of course, with a proportionate increase. The length of time to which the leaf is subjected in firing varies from 40 to 120 minutes. The general average may be taken from 45 to 60 minutes; 7 lbs. per firing is the usual amount fired in each pan, and in a working day of ten hours about 62 lbs. may be taken as a fair average. An American gentleman resident in Yedo in the employ of the Japanese Government, and who has given considerable attention to the subject of tea-firing, is inclined to condemn the present somewhat crude mode, and advocates the employment of steam to attain the purposes required. His argument in support of the use of steam is, that the expense of firing would be much reduced by reason that fewer hands could superintend a larger number of pans, that the application of the heat could be better regulated, and that the essential principles of the leaf would be retained to a much greater degree than they are by the present mode of firing. He admits that this process would turn out the leaf quite dissimilar from its present appearance after firing; it would be green in colour instead of black or dark brown, and the twist in the leaf would be lost. How far consumers might be brought to like this change in the form, colour, and general appearance of the leaf, is another question.

It must be remembered that when a leaf is dried, the tannin, or astringent principle, in tea remains undisturbed, while the aromatic principle is in a measure lost. The aroma of the leaf is the result of the careful exhibition of heat at a certain height of temperature, and of a certain duration, by which an essential oil is produced.

I have made inquiries as to whether experiments have ever been made to apply steam to tea-firing. It appears to have been tried in one or two cases, but abandoned, principally, I understand, from the fact that the requisite amount of heat could not be brought to bear, and not unlikely too from the fact that the out-turn of the leaf after such process is unsightly, and an abrupt change from that to which the eye has been accustomed.

I should add that the gentleman to whom I have above alluded instances the preserved vegetables supplied to troops during the American war. Steam had been used in the preparation of these, and to this their brilliant colour and full natural flavour is attributed.

Nearly all the tea exported herefrom finds its way to the American market, being in high favour in the United States. I submit a comparison of Japan with China teas, to understand which it should be borne in mind that, although each tea-pro-

[1] The tsubo is 36 square feet.

[2] The kin = 160 momme, or 1·332 English lbs. avoirdupois, the English lb. being 120 momme. In Yamashiro, in dealings between natives, the kin is 200 momme.

ducing district in Japan may claim for its production a special title to the favour of the purchaser, the terms used by the foreign merchants in designating the qualities do not comprise particular appellatives as in China, but are confined to fine, medium, choice, &c., thus :—

Japan fine, finest, and choice, rank with fine to finest China Moyune greens ; medium to good medium with good to fine Foochow or Amoy Oolangs ; and low medium and good common with good cargo Oolangs.

Thus the four provinces of Yamashiro, Ise, Suruga, and Inshiu, which produce about two-thirds of the crop, and are well represented in the market, are graded as under :—

Yamashiro (1) fine and choice.
Ise (2) good medium to finest.
Suruga (3) medium to finest.
Inshiu (4) good common to fine.

The Ise and Suruga teas are probably most in favour, but there are more grades known in the Yokohama market than those just mentioned, which I beg to particularize as under :—

Ordinary (Bancha), very low class, barely sound.
Good ordinary, ditto.
Common, just clean with a bad leaf.
Good common, drinkable, moderate leaf.
Medium, clean and sweet with fair leaf.
Good medium, good clean liquor, good leaf.
Fine, sweet fragrant with good even leaf.
Finest, sweet, fresh, and fragrant with handsome even leaf.
Choice, fresh, fragrant, pale liquor, handsome and blooming leaf.

A small Japanese work published in Yokohama, sketches the mode of rearing the tea plant, and the preparation of the leaf for the native consumer. As its pages are not without interest I quote as below from the work.

Pick the tea nuts in the autumn when they have attained a full dark colour, dry them well until they open, then store them ; the nuts or seed that ripen and fall are also good for sowing, but are generally rendered worthless owing to the depredation of moles.[1]

The preparation of ground for the reception of tea seed is as follows :—A hole about two feet in diameter is dug and well-manured, earth sprinkled over this and the seed can then be sown ; the best kind of earth for this purpose is good black soil, or what is known as hill soil ; it should not be clayey but friable, the ground should have a south-easterly direction, and localities should be chosen with a due regard to a warm temperature. The great object is to guard against northerly and westerly winds ; the land should be laid out in the same way as for vegetables, that is, in ridges, and well-manured.

The time for sowing is just about the break-up of winter and commencement of spring, when the snow is disappearing from off the ground.

The lid of a tub about eight or nine inches in diameter is taken (or what will do as well, the straw top of a rice basket), and in this is mixed a small quantity of tea seed and guano ; the guano is used to keep off the moles ; the seed is then sown over the plantations, and the sowings covered with a little earth. The ground is prepared in the winter in the manner above described, and, when sowing, it is as well to cover the seed with a little rice bran.

The plant shows up well in about fifty days.

The first year the plant attains to about two inches, grows to nine or ten inches in the second year, throwing out a couple of branches ; and in the third year grows to about a foot and a half, with five branches. It is only in the fourth year that the first year's leaves are picked. When the time approaches for the picking a little soil is taken from round about the plant, and as the summer comes on grass is strewn where the soil has been removed, and in the autumn earth is strewn over the grass. The same plan is pursued every year. Plenty of manure must be used in as large quantities as judgment dictates.

In the third year, when the plantation is covered in different places with thick growings, the plants are separated both in spring and autumn and planted out, the ground being well manured beforehand for the reception of the plants.

Manuring should take place on plantations in the second and towards the end of the fourth months ; also in the height of the summer and in the depth of the winter ; in all, four times. The manure should not be used sparingly, and the winter manuring, if the snow is on the ground, should be heavily laid on. As the plant grows, care in manuring is of great importance.

Refuse oil-cake, the excreta of silk-worms, and fish manure, are largely used in tea cultivation.

[1] The seeds are picked in the autumn, and are sold by the koku, a measure equal to 5·13 bushels, at various prices. At Ogura last year a koku of seeds from the best trees was £2 8s, from the inferior, £1 4s. At Koata it was £1 10s. In the districts producing inferior tea it is often not more than 6s.—MR. LAWRENCE.

The picking season depends upon the locality and consequent temperature, and on the character of the season or harvest. The first picking is generally made after the lapse of eighty-eight or one hundred days from what may be called the appearance of spring, when, out of every five or six new leaves all are picked but one or two ; these make the best tea, which divides into many qualities dependent on the preparation ; the picking ought to last ten days.

The process of steaming tea is as follows : As soon as picked it is at once steamed, all damp or wet leaves being thrown on one side, excepting those that may be a little wet with dew. In order to obtain the proper application of heat a few leaves are put into a shallow basket, spread out evenly, and the lid put on ; the basket is then placed over a charcoal fire-box or stove ; a perfume is at once perceived ; when the greeny smell has subsided, the leaves are removed and spread on a piece of new matting and fanned briskly, so as to draw out the heat ; after the lapse of some little time the tea is placed in a tray, and then undergoes a fining process, the length of which is regulated either by the minute hand of a watch or the beats of a pulse, and depends a good deal on the manipulator's own ideas.

The further process of preparing the tea is to place in a fine box a small quantity of best charcoal ; over this is laid evenly the half of a rice bag, which is then ignited. When burnt through, a gridiron is placed over the ashes of the rice bag and on the gridiron a tray. The tea that has gone through the steaming process is then placed on the tray, and the leaf quickly manipulated with the hand ; if done slowly, the leaf is liable to become red in colour and the quality deteriorated. The leaf is then gathered into a pan by means of a small hand-broom ; a piece of clean matting is laid over a wooden flooring, and on this the tea is worked about with the hand, is replaced on the fire for another firing, and so on again and again, after which all traces of wet or damp should be removed from the leaf. As soon as dried the leaves are ranged on a kind of wrapping paper, and are carefully separated ; they are then well sifted and laid out on a table, once more fired over a moderate fire, then cooled, after which they are placed in jars, these being carefully covered so as to guard against the entry of air. The general preparation, of course, differs, as judgment may dictate.

As many firing boxes are used as there are hands to work them.

A wooden flooring is provided in the room where the tea is steamed and cooled.

The second leaf which sprouts after the first picking produces what is called second class tea ; the leaves succeed one another in rapid succession. The mode of picking and preparation differs in no way from that already described.

If the year is exceptionally droughty the plantation suffers, and a second crop should not be picked.

The choicest teas are distinguished by different names in the various places where they are grown. The older the shrub the better the tea, so that every care should be paid to the cultivation of old shrubs.

In the spring and on the approach of hot weather the plants are shielded from the sun's rays with matting, and a covering roof made of reeds is generally provided, so as to keep off rain and dew ; but the most important thing is the manuring.

The picking and preparation of old and new leaves differ in no particular.

When the tea is to be sent any distance it is placed in plain earthenware jars, well coated with paper ; chests are likewise used, but also with the paper coating. The apertures of either chest or jar should be carefully closed.

As regards the storing of tea, damp being peculiarly injurious, a place should be selected with due regard to the exclusion of wet and damp ; the situation should be south-easterly, and such as to admit plenty of sun : exceptional care should be taken during the rainy season.

If damp gets at tea the leaf loses both colour and flavour, neither of which can by any means be recovered.

Turnips, barley, &c., may be grown on the plantations in the open spaces between each shrub, but all plants having great pungent properties, such as tobacco, &c., should be avoided.

Such is, in substance, the information that the work supplies, but to guard against misapprehension I should state that the numerous firing processes which it is stated the leaf goes through last but a very short time, and when the leaf reaches the Yokohama market it is, as before observed, but very partially cured or fired, and by no means sufficiently so for foreign taste.

As a rider to this Report, we add a few notes from Consul Wilkinson's :—

The foreign merchant purchases the tea in his own warehouse. A sample is brought to him by a Japanese vendor, whether owner of the teas or only an agent, he does not know. He buys the parcel according to the sample. The parcels differ in size. Early in

the season there are usually 10 or 12 piculs in a parcel; but later on, parcels are sold of 100 or 200 piculs, or even more. The ordinary teas come down in rough-made chests, papered inside, each chest containing on an average 60 lbs.; but the finest descriptions come down in jars, holding from 35 to 36 lbs.

On the arrival of the tea it is first inspected to see whether it is equal to muster. If it is accepted it is then fired. This is done, as has been already stated, in iron pans. These pans are of different sizes; the larger sized, called Canton pans, will fire about five pounds at a time, and the smaller sized, called Fychow pans, fire about three pounds. Some of the pans are set flat and some sloping; some teamen preferring one way and some another. They are attended to by women; one woman will attend to one Canton pan or two Fychow pans. There is a charcoal fire beneath the pan, and it is the duty of the attendant to keep the tea constantly moving to prevent it singeing and to give it all an equal firing. Teamen differ in opinion as to the best mode of firing, and the time occupied therefore varies considerably, the shortest being about thirty-five minutes, and the longest an hour and a half. On the average, however, a woman will fire about 40 lbs. a day. After the tea is fired, it is now generally sifted. One house makes use of a machine for the purpose, but it is commonly done by coolies with hand sieves. It is then weighed into half chest boxes, so that all the boxes of a particular line of tea may be of the same weight. The average weight is about 46 lbs. The weight depends on the quality of the tea. The lower the grade, the lighter it weighs. Thus a box which will contain 55 lbs. of the choicest tea will have only 44 lbs. of the common grade. The boxes are lined with tea lead, which is soldered down. The lids are then put on, and the labels pasted on the face of the box, and glazed over with tea oil. When this is dry, usually the next day, the boxes are matted, and a label similar to that put on the face of the chest is put on the matting; this label is also oiled. The boxes are then ratanned, and are ready for shipment. For the San Francisco market a small quantity is put up into 1 lb. paper-parcels and 4 lb. boxes, but tea does not keep well in small packages, and the paper of the parcels spoils the flavour.

When the tea is packed in half chests it is packed while still hot, as it then packs closer, and keeps the flavour. But it is found that tea in cooling gains weight even if soldered down, the usual increase being about 1¼ per cent. When it is packed in bulk in chests the merchant gains this; but when it is put into 1 lb. parcels, these cannot be sold as more than 1 lb. each. In order therefore to have the exact weight, some of the merchants let the tea cool before parcelling it.

The hands employed in the firing go-downs are either Chinese or Japanese. One or two Chinamen superintend the work, and the rest are all Japanese. Japanese women attend the pans. Their wages, which in 1869 was about 8 or 10 tempoes a day, is now from 16 to 20 tempoes, the tempo at present being not quite ½*d.* The carrying, weighing, packing, and other heavy work is performed by Japanese coolies, of whom there is about one to every six women engaged in firing. Thus in one go-down, where there are 180 women employed, there are 30 coolies. The wages of the latter are from 15 to 22 tempoes a day.

We now come to the more uncertain question of figures and statistics. At the request of Mr. R. G. Watson the Japanese Government instructed Mikamoto Koichi to make a return of the teas grown in all the "kens" into which the country is subdivided. He succeeded in rendering the returns for sixty-seven out of the whole seventy-five "kens" as being 14,506,384·8 catties = 19,341,846·4 lbs.; but he acknowledged that these returns as they stood, having been the first of their kind, and encountering much jealous opposition, were only approximate. Mr. Watson, Mr. Dohmen, Mr. Flowers, and the principal British merchants, agreed in estimating the quantity exported at some 18,000,000 lbs.; and the native Vice-Minister of Finance and Commerce assured them that the annual consumption of tea by the Japanese was about equal to the total annual export of tea to foreign countries; and they all agreed in accepting that total amount as being 36,000,000 lbs., or double of the exports.

Even in the various ports the export returns of the custom-house and the chamber of commerce considerably differed. Mr. Robertson, however, was able to forward the following as the official returns from the two ports of Hiogo and Osaka for four successive seasons :—

Season.	To Foreign Countries.	To Open Ports in Japan.	Total.
	Lbs.	*Lbs.*	*Lbs.*
1868-1869 (1st July to 30th June) . .	173,866	2,693,734	2,867,600
1869-1870 „ „ . .	1,448,864	1,338,770	2,787,634
1870-1871 „ „ . .	2,740,134	2,166,657	4,906,791
1871-1872 (1st July to 31st May) . .	4,129,170	1,148,698	5,277,868

The 2,166,657 lbs., given as shipped to open ports in 1870-1, include 1,733,280 lbs. shipped by native merchants in foreign bottoms.

In 1872, however, on account of the early delivery of the teas, the season was reckoned from the 1st June, an arrangement that seems likely to last for the future.

The following return gives, so far as can be collected from the chamber of commerce returns, the destination of the shipments to foreign countries :—

Season.	To the United States.			To Canada.	To London.	To Ports unmentioned.	Total.
	New York and Boston.	San Francisco.	Total.				
1868-1869 .	—	—	—	—	—	173,866	173,866
1869-1870 .	1,259,762	91,760	1,351,522	—	—	97,342	1,448,864
1870-1871 .	1,979,485	120,047	2,099,531	—	221,022	419,581	2,740,134
1871-1872 .	3,692,974	80,840	3,773,814	96,641	—	258,715	4,129,170

It may, urges Mr. Wilkinson, be fairly concluded from these returns that the total exports are increasing, that the proportion shipped direct is increasing, and that of the shipments direct an increasing portion is going to the United States.

This is shown even more forcibly by Consul Robertson's first report. Writing from Yokohama, he states that the cultivation of the tea plant in Japan has been carried on over an increased area of plantation since the opening of the country to foreign trade, and, unless some unfavourable reaction should take place in the demand for this staple of Japanese production, an increase of some 15 per cent. per annum may be counted on for the next few years.

Giving 15,720,000 lbs. as the present estimated annual production of those districts which have for their outlet the port of Yokohama, he states that the export of tea from the 1st June to 12th December, 1872, has been—

	Lbs.
To New York	6,729,150
San Francisco	1,655,083
England	Nil.
China	Nil.

A notable increase on the figures in the comparative table below :—

	1871-72.	1870-71.	1869-70.	1868-69.	1867-68.	1866-67.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
To New York .	4,562,260	3,782,596	1,606,425	2,995,190	2,459,417	1,964,083
San Francisco	1,064,172	1,059,682	376,694	411,311	141,650	863,689
England .	—	—	—	605,753	294,506	92,089
China . .	—	—	—	1,800	49,436	—
Total .	5,626,432	4,842,278	1,983,119	4,014,054	2,945,009	2,919,860

The teas of Japan are never, like those of China, distinguished by their names or districts, but always by their qualities. He quotes the prices ruling in Dec., 1872, as follows :—

Per picul of 133⅓ lbs. avoirdupois—

	Dols.
Common	24 to 25
Good common	26 „ 28
Medium	30 „ 33
Good medium	35 „ 38
Fine	39 „ 43
Finest	44 „ 47
Choice	50 and upwards.

Consul Wilkinson has some pertinent remarks upon the difference in taste for teas in England and the States, and shows why in the latter there is such a large and increasing demand for teas of Japanese origin.

Japan teas find very little sale in the English market. Out of 145,000,000 lbs. of tea imported into the United Kingdom in 1869, only 1,036,000 lbs. were Japan teas, and in 1870 the proportion was still less, being only 397,000 lbs. out of 140,000,000 lbs. Nor does the whole quantity imported, little as it is, enter into consumption in England. Most of it finds its way to the United States or Canada. It is very questionable indeed whether Japan teas ever entered extensively into consumption in England, for although for a few years after the opening of Yokohama to foreign trade a much larger quantity of Japan teas were sent to England than at present, they were then repurchased for the American market. They were sent to London because it was the great mart for teas of all kinds. The tea trade was then principally in the hands of English houses, and the tea was still sent home by sailing vessels round the Cape of Good Hope. But the Pacific Mail Line of steamers, which began to run be-

tween China and Japan and San Francisco in 1867, offered such facilities for rapid and direct communication with the United States that the trade gradually ceased to follow the old round-about course. Direct importation with the United States will also be still further stimulated by the new tariff which came into operation on the first day of July last, by which the duty was abolished on all teas imported direct from the place of origin, while a duty of 10 per cent. is levied on teas imported through other countries.

I have not the returns of the imports into the United States during a complete series of years, but some idea of the proportions imported may be gathered from the following figures taken from a New York circular. The imports of tea into that port from the 1st of January to the 20th of June, 1871, are given as 36,000,000 lbs., of which 7,500,000 lbs. were Japan teas; and during the corresponding period of 1872 there were 8,000,000 lbs. of Japan teas out of a total of 37,500,000 lbs. imported.

The taste for teas differs in America and in England. In America the prevailing taste is for green or uncoloured teas, while in England it is for black teas; and it has been found easier and more profitable to prepare Japan teas as the former than as the latter. The difference between these two classes depends partly on the original quality of the leaf, as one tea is naturally more suitable for being made a green tea than another. But it depends also on the preparation, and it is possible out of the same leaf to make either green tea or black tea. In the preparation of black tea the leaf is taken when fresh, and after it is picked it is wetted and put into baskets, where it is allowed slightly to ferment. In China this is done in the native hongs, where the tea is brought at an early stage. But the Japanese have not yet adopted this method, and when the teas reach the foreign merchant they are no longer in a fit condition for undergoing the process. This difficulty might be overcome; and I have seen a small parcel of Japan tea thus prepared, but it would not be found remunerative. There is a want of body in the Japan tea, and lower grades would not compete successfully with the corresponding grades of China tea. The latter can be produced more cheaply, and gives a liquor more suitable to English tastes. In the original quality of the leaf, too, Japan teas are more suitable for green teas. In Awa there is some tea of a darker colour, but it is not a large item in the market. They are not, however, equal to the green teas of China, and cannot compete with them successfully in the English market.

The colour of the liquor which Japanese uncoloured tea draws is like that which is drawn by fine oolongs—a pale olive; but it is not so bright as that drawn by the finest grades of China green teas. Great importance is attached to the colour of the liquor drawn by all these teas, as it is a rule that the finer the grade of the tea the paler is the liquor it draws. In ordinary China black teas the flavour of the liquor is considered much more than the colour, which is generally reddish. It should not, however, be muddy, as that indicates that it has been adulterated.

In spite of our present distaste for the teas of Japan, it is still the belief of many eminent authorities that that country will yet play an important part in the supply of that most essential article of European commerce. Given English capital—that is, English machinery—English energy and English ingenuity to set the lead—for the Japanese have, after the first start, energy and ingenuity enough of their own—and the attempt must indeed be difficult if a country with great tea-producing capabilities and a vast commercial future cannot afford such samples of all and every grade and taste and colour as may satisfy our most scrupulous and experienced teamen in London or elsewhere.

H. C.

THE MINES AND MANUFACTORIES OF UPPER SILESIA.[1]

General History of the District.

TO-DAY by a mere glance at the map of any country we can accurately estimate its wealth and vitality. The closer the lines of railway run together, the oftener they cross and intersect each other, the richer and more full of life should that country be esteemed. This dictum, true for empires, is true also for districts; and if on the map of any region we notice any points almost entirely covered with black lines, parallel, crossed, and recrossed, we may certainly conclude that at those spots coal, the great aliment of modern life, has been discovered.

In the West of Central Europe, near Charleroi, Liége, Duisburg, and Sarrebrück, the iron roads run off in all directions; in the east of central Europe numerous lines are concentrated so as to cover a confined space in the form of a quadrilateral, the extreme points of which are Kosel and Katowitz, Tarnowitz and Ostrau. This quadrilateral has a base of about eighty-five kilometres, and inserts itself like a wedge between Russia and Austria.

On the main line from Breslau to Vienna, four railway lines start off almost parallel, but all inclining somewhat towards each other, so as to meet again at Katowitz; from thence two other lines start, one towards Czentochau and Warsaw in the Russian territory, the other towards Tzerbinia and Cracow in the Austrian empire.

Around Beuthen, the administrative capital of the country, the main lines, branches, and district sections are multiplied to such an extent that the soil is covered with a veritable network. As in the basin of the Ruhrt, as in the valley descending from Saint-Etienne to Givors, the presence of coal has determined an industrial movement so much the greater because alongside the coal beds Nature has accumulated rich stores of iron, lead, silver, zinc, and limestone.

It would require some years of study, and a space of many volumes, to give a complete description of the geological soil of Upper Silesia, of its mines, and of its manufactories; the number and importance of which are increasing day by day. Perhaps at some future date we may undertake this task; to-day we can relate only what we ourselves were able to see during too short a sojourn, and we will resume the precious documents which have been placed at our disposal, thanks to a friend as kindly and obliging as he is well-informed.

The principal aim of our journey was to study the Silesian processes in the washing of calamine, and the extraction and treatment of zinc; but in these countries of Northern Germany, on which the attention of Europe is now so deeply fixed, everything we saw excited in us a lively interest, which we are persuaded that our readers, too, will find in our description, however incomplete this description may be.

The journey to Upper Silesia shows many things quite different to those at home, and leads to a spirit of comparison not altogether advantageous to the French railway lines—carriages broad and lofty, a speed equal, though rapid, succeed to the low narrow carriages, the unequal and tardy pace of the French trains. The further off we go the more the comfort increases; starting from Breslau we notice that the carriages are little saloons, furnished with couches and moveable cushions, communicating with dressing-rooms in which there is plenty of water, and opening upon little terraces where one can take the air lazily, and watch the changing landscape. In winter our insufficient hot-water feet warmers, the renewal of which is so inconvenient especially at night, are replaced by stoves; all this is certainly still far from the travelling hotels and restaurants of the Americans, but still it exhibits a very considerable step in advance.

Leaving Oppeln we begin to foresee the approach of a large industrial district; lime kilns, numerous and gigantic, belonging to different companies, rise on each side of the way, especially in the environs of Gogolin; when Gleivitz is passed the huge smoky chimneys and the high blast-furnaces begin to show themselves from afar; from Zabrze to Mislowitz, the rails cross a coal-basin, the surface of which is covered with manufactories, and which possesses for the manufacture of iron alone, putting the other industries altogether aside, more than eighty blast-furnaces in full work and activity.

On descending from the train, one's eyes are at once attracted by the curious construction of the carriage roads; a pavement, or rather a kind of macadam, in large lumps, of an extremely hard substance, which only, and even then not for long, is able to resist the incessant wear and tear of the carts bearing ore, limestone, cast iron, bars, and all the other primary substances, or the not less weighty product of metallurgical industry.

After having employed the natural stones of the country, and then using granite and basalt brought from a distance at a great cost, and yet proving altogether insufficient for the requirements of the case, they ended by covering the roads with the residuum which is incessantly renewed around all the blast furnaces, and which, sheltered from contact with the air, cools slowly and yields an opaque brownish green product of great resisting power; it is simply the slag or scoria which is so friable in a vitreous state, and ordinarily so encumbering, as to be scarcely suitable even for rubble.

The incessant traffic, which eventually reduces this slag, or schlacke as the natives call it, to powder, is executed by carts on four wheels, dragged by Polish horses, somewhat too slight for

[1] Translated from "Les Grandes Usines" of M. Turgan.

this labour, but very elegant in form and full of courage and pluck.

Cart-shafts, as far as we saw, are unknown in the country; every vehicle has a long pole, and when there is only one horse they fasten him to one side of this pole; and harnessed in this fashion he has to make the cart go through all the necessary manœuvres. It is the same with the omnibuses carrying passengers to or from the railway stations; a single horse, fastened generally on the off side of the pole, drags these carriages with ease and facility.

In France they would believe it impossible to utilize such a manner of putting the horses to, which with us is reserved solely to carriage-builders, taking home carriages to their purchasers; in Upper Silesia in exactly the same way, they look upon our two-wheel carts as barbarous. The ground slightly undulated, and rising from place to place in little hills with a very large base and a very feeble slope, readily allows the employment of that species of vehicle in which the power of the horses can be best utilized. The question of two wheels or four for a cart is one of those debatable points with which men occupied with horses have for long been engaged, without any power to modify the usage of the different nations who have been used to such or such a mode of traction.

Nothing could seem stranger to French eyes than to watch the halt of a long line of these carts, each dragged by a single horse, eating his oats from out a little box fastened to the pole, all standing in single file before the different establishments. The horses and the carts are for the most part the property of agricultural peasants, who make one or two journeys each day, according to the distance of the mines from the manufactories, and spend the rest part of their time in farming. These carts, moreover, are somewhat expensive.

The horses, costing, as a maximum, four hundred francs, are very tough, inured to every fatigue, and are contented with a very mediocre feeding. A cart with one horse brings its proprietor five or six francs a day. With two horses, the cart returns from twelve to fifteen francs. In Lower Silesia the horses of German breed are very large and powerful, and are worth as much as twelve hundred francs.

Coal, the fundamental wealth of the country, without which the other mineral treasures would be unworkable, is found at a depth varying from fifty to two hundred metres. The return for 1867 puts the number of the coal mines at 449. Since that period other pits have been sunk, and others, again, are in course of sinking.

Their total production for 1867 was 85,646,415 quintaux or hundredweights, that is, 4,282,320 tons, and 92,637,761 cwt. or 4,631,888 tons in 1868.

All these mines are not worked: several are connected together; only a few produce considerable quantities; many are stopped from different causes.

Studying the statistics of M. Sabarth, we see that König, the most important working, has yielded 4,133,184 Prussian tons.[1] It belongs to the state, forming part of the reserve held by the public treasury ever since the time of Frederic the Great. The public treasury also owns another pit, Königin Luise, which is put down as producing 2,596,478 tons.

The Silesian company possesses the most important mine belonging to any private individuals—the Mathilde, with an output of 1,193,785 tons, as well as the mines of König Saul, Centrum Jacob, &c. Other pits belong entirely to different individuals, such as Concordia and Amalie to Count Guido Henckel-Donnersmark; Hohenlohe and Alfred, to Prince Hohenlohe; Hedwigswunsch and Brandenburg to Count Ballestrem; Gottessegen Siemianowitz to Count Hugo Henckel-Donnersmark; Florentine to Madame Tiele Winkler; Charlotte to Professor Kuh; Emmanuelssegen to Prince Pless.

A kind of syndicate, under the title of "Gewerkschaft," composed of several united proprietors, works Luisenglück, Oscar, Morgenroth, Wolfgang, Leopoldine, Hugotswang, Elfriede, and Catherina.

This sort of syndicate was rendered necessary by the ancient laws by which the property for some metres round the pit-mouth was assimilated to that of the soil generally, and had to be divided by a deed analogous to a notarial deed. The proprietors were submitted to a nominal registration. With the infinite division of these heritages this morselling out of mining property would have rendered any working on a large scale by the gigantic mechanical processes of the present day altogether impossible. The union of the proprietors under the direction of a few delegates was thus indispensable.

The bequeathing of portions and shares to charities, schools, and special funds rendered the society's administration still more difficult. Moreover, the royalty to different owners who enjoyed the fiscal rights by privilege and a variety of other perplexing combinations, proved an eternal source of lawsuits on the part of some of the owners against the others.

Even at present the property and working of the coal or metal mines, which do not belong to the state, are very complicated; in short, these mines belong either to individuals, to companies, or to societies. Thus, for example, a Silesian man of business might be at one and the same time sole proprietor of mine A, owner of several portions in mine B, member of the syndicate C, and shareholder, by purchase, in the anonymous society D. Beyond this, he might have rights of royalty over a collection of mines; and he thus incessantly finds himself involved with himself in five different ways. On the other hand, a mine may belong to a single proprietor, or be divided into portions, belonging, some to individuals, others to societies, all depending upon the governing syndicate.

This complication resulted from the line followed by the industrial movement of the country, which it is difficult for a Frenchman at a first glance to comprehend; yet it has such a resemblance to the entanglements of the ancient German Confederation that to German minds it appears natural enough.

The following translation of a passage from Steinbeck glances at the old process of working zinc mines, and at the manner of proprietory.[1]

The history of this mineral, formerly very little esteemed, but which has now become one of the most important branches of our national wealth, has, like that of lead and silver in the Tarnowitz district, been collected and published by Abt, a former imperial counsellor for mines, who had all the documents relative to the subject in the archives of Anspach placed at his entire disposal.

His work on calamine was first printed in the provincial sheet of Silesia, vol. xii. p. 139, with the signature A. It was afterwards reproduced, with a few variations, in the *comptes-rendus* of the "Society for the Development of Trade in Prussia" (year 1825, p. 75), with the title, "History of the Extraction of Calamine in Silesia, communicated by Lewald of Breslau."

It appears, according to this author, that the first certain information upon calamine, though very obscure and contradictory, is to be found in Pliny ("Hist. Nat." lib. 34, cap. 1, 2, 10); under the denomination cadmia he probably means the blende and the débris of the zinc furnaces, and under the denomination calcis or calcites calamine was intended. Later on there is a vague reference to calamine in Albertus Magnus ("De Mineralibus et Rebus metallicii libri quinque," Cologne, 1569, p. 484). It is supposed that in book v. chap. 5, the marchasita and magnesia was a substance composed of sulphur and mercury, which with an alloy of copper yielded a white colour.

Comparing calamine with sulphurated pyrites, he says:—

"Magnesia vero sulphus plus turbidum et argentum vivum magis terreum et fæculentum, et ipsum sulphus similiter magis fixum et minus inflammabile habere, per easdem probare experientias manifeste poteris et ipsam magis naturam martis exprimere."

If we may trust the alchemists, it seems certain that Albertus Magnus really had a knowledge of calamine, and that at the end of the thirteenth century it had already been used as an alloy for copper. However, judging from the very obscure data that have reached us, they generally used the zinc coming from the blende, although the Romans employed calamine for that purpose, if we may take the accepted signification of the passage in Pliny, lib. 34, cap. 1.

The extraction of calamine was commenced at Aix-la-Chapelle, in 1430.

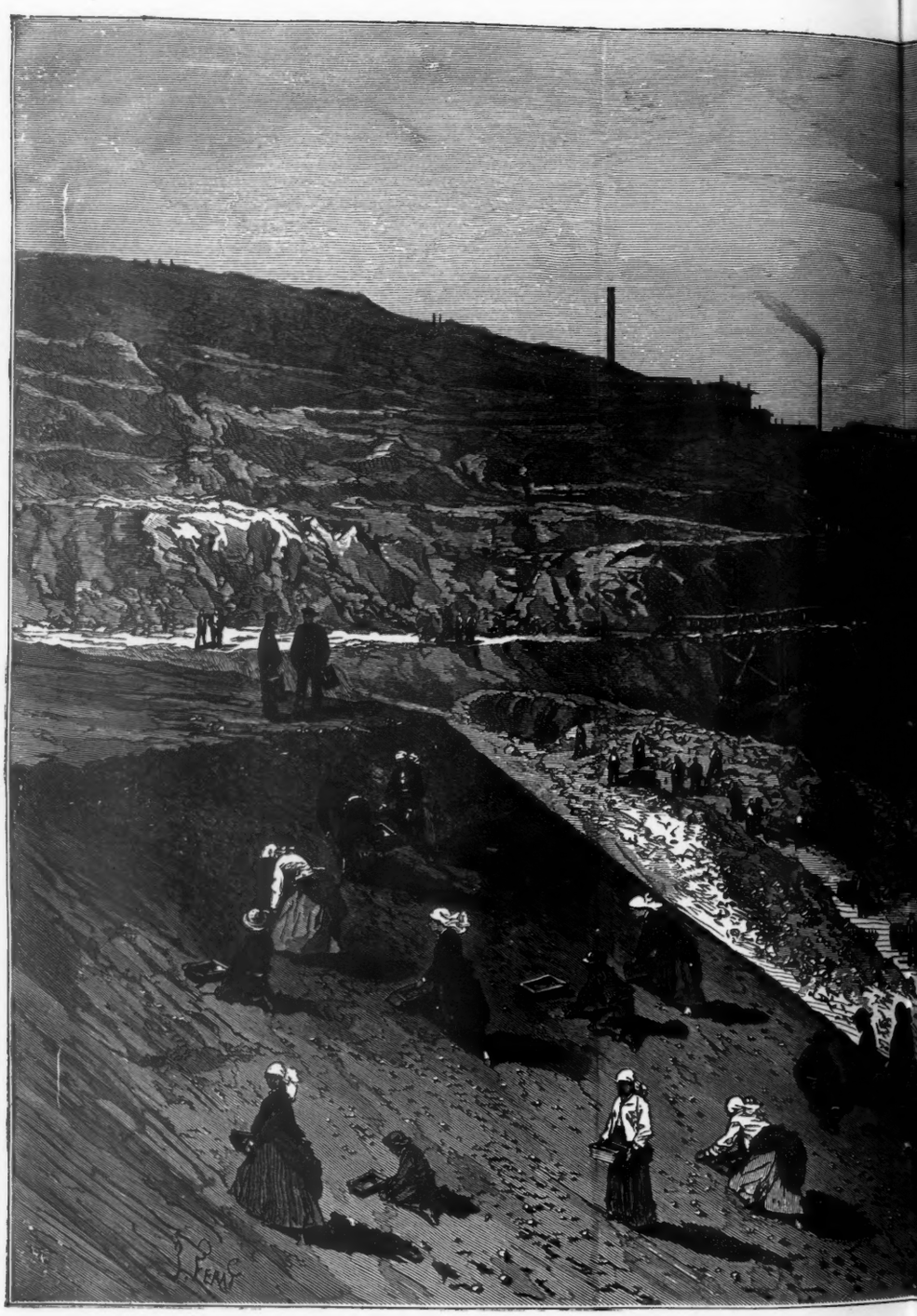
On the 12th Nov., 1565, one Gregory Emich, director of the mint at Jægerndorf, wrote to his sovereign:—

"That he had established at Jægerndorf a brass manufactory, and that up to the present he had, at a great cost, brought the calamine by water (probably from Aix-la-Chapelle). This had led him and his associates to seek for calamine nearer, and he consequently prayed the prince to deign to grant such a concession, for any place I might be able to find calamine in the principalities of Jægerndorf or the lordship of Beuthen, that I may have the power to enjoy all, sell or pledge, &c. in a manner that shall not be conceded to any other person." More than this, he demanded exemption from all imposts during six years, after which he would pay off the debt on the same scale as the other similar establishments who employed calamine. There is no trace of this Emich ever having received a reply, or that he actually explored for calamine.

Some years later, one Peter Jost, of Tarnowitz, wrote under date of 4th August, 1569, to the Margrave George Frederic, that after the researches he had instituted and the expenses

1 The Prussian ton contains 175 kilogrammes.

1 Steinbeck's "History of the Mines of Upper Silesia."



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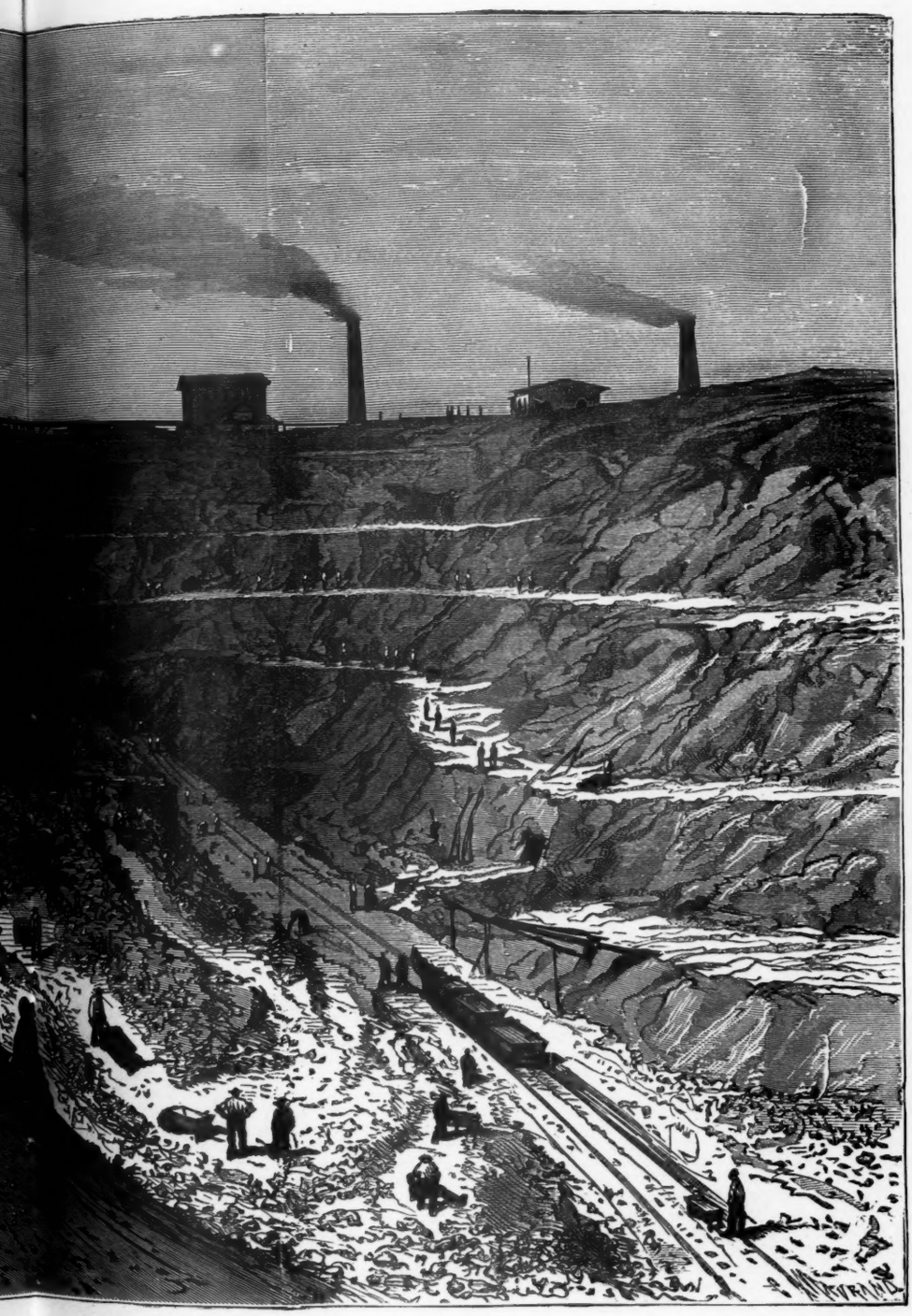

AIR AT THE SCHARLEI ZINC MINES.

he had encountered, he had discovered a calamine stone which produced brass; and that "he and some few associates intended to establish a brass manufactory, and that they asked for a privilege for twenty years." Beyond this he demanded that if any other persons discovered calamine by chance they should not be allowed to transport it beyond the lordship of Beuthen, but be compelled to sell it to him or to his establishment.

As no separate metals could be produced in this manner without the lord of the manor claiming by right three-fourths of the royalty, he proposed to pay his dues each year in sterling cash.

Soon after the same Peter Jost declared under date 27th August, 1569, that he intended to transfer his brass manufactories elsewhere, because the lead and silver establishments of Tarnowitz were able to reasonably complain of the large consumption of wood and coal in that country.

He declared himself ready to continue working the mines, and if in the deepening of the pits he discovered lead ore, he was for his part ready to renounce it, but if in the old or new lead workings calamine was discovered he would appropriate that to himself. A decree of the lord of the manor, dated Onolzbach, 10th October, 1569, and addressed to Jægerndorf, states that if Peter Jost comes to terms with the society for the extraction of lead at Tarnowitz, and if all things are in due order, he will grant him the permission he requires.

Up to the year 1580 we have no other information; nevertheless, Peter Jost must have continued the extraction of the calamine, and its employment in his brass factory at Jægerndorf, for on the 19th June, of the same year, the council of Jægerndorf declared to the owner of the Trapp mines at Tarnowitz, that the actual proprietor of the brass factory, situated in the lordship of Jægerndorf, was leased for calamine by Hans Hormig, citizen of Breslau; that Hans Hormig permitted himself to sink shafts on his lands close to Tarnowitz; and that thus a prejudice had arisen against the brass factory, &c. That they (the council) did not know if the calamine belonged to the lord of the manor, or if Hormig had authority to dig; that the master of the mines desired a reply upon this subject. But, while even admitting that Hormig had a right to the calamine, the Office of Mines could on the part of its own chief have forbidden it to be worked to the prejudice of another.

The report of the master miner, Trapp, dated 7th July, 1580, states that he had spoken with Hormig, but that this latter did not wish to submit, pretending that the laws relating to mining contained no mention of calamine at all, and he could consequently do whatsoever seemed to him good, and that, moreover, he wished to make a report from his own standpoint.

No trace of this report has been found.

Soon after this the right of working calamine in Upper Silesia was requested by other persons, living in more remote parts of the country.

George Rosenberg, citizen of Dantzig, writes from Dantzig on September 14, 1580, to the Margrave George Frederick, who at that period was stopping at Justenburg in Prussia, as follows:—

"He has learned that Caspar Goebel, also a citizen of Dantzig, has recently asked the Margrave to let him the calamine mines situated in Upper Silesia; that his lordship had delayed his decision until his journey to Prussia; that he (Rosenburg) would not let it be ignored that with the aid of his brothers he had, about a year back, fitted a factory and a brass foundry, which had occasioned him a serious outlay; that Caspar Goebel as well as Hans Bolmann had obtained from the King of Poland a privilege according to which they alone had the right of extracting calamine; that nevertheless these two individuals, at the request of the king's procureur, had been cited for certain reasons before the upper tribunal, where they should have left their monopoly."

A report, bearing date 17th April, 1581, says that:—

"Calamine resembles limestone, and is of a white colour; it is found underground in the Beuthen circle; they employ it for the manufacture of brass; one ton, containing six or seven hundred weight, is sold for one-fourth of a thaler. The proprietors of the land pretend that calamine is a fruit of the earth (*fructus fundi*). At present it is very little used and consequently there is very little profit. For this reason it does not appear prudent for his excellency to create difficulties with the rights. They say there is much calamine in Poland, but, as they pretend that the nobility have made profitable use of it, the seigneur can grant no rights. They know nothing more of this Caspar Goebel if it is not that he was at Tarnowitz, that he took all manner of notes and collected information, and that they did not treat with him. In every case he sees no reason at all why his excellency should make arrangements with anyone. If, however, he perceives any advantage, he will not fail to send information immediately."

Melchior Brandt, foreman of the brass factory at Jægerndorf, in a report he addresses to the Margrave George-Frederick dated 10th October, 1582, says incidentally that this establishment during the whole twenty years of its existence had never been so well conducted in the interests of the associates of Breslau as at the time of writing. The establishment must, then, have been founded in 1562.

Many persons still solicited the right of extracting calamine; among others, one named Hans-Jostel, a Tarnowitz jeweller; he presented his request under date of 26th June, 1584. The seigneur demanded a report; the administration on the 18th August, 1584, made the same reply that it had already given on the 17th April, 1581, adding, however, that Hans Hormig having treated for calamine with the nobility, and having handed over to them his brass foundry at Jægerndorf, the seigneur cannot concede to another the right of searching for calamine.

At the same time they note that calamine had been discovered at Radinkoff (now Radzionkau), at Boberkoff, Boberkowsky (Bobrek), Silberberg, Tzhuybar (Czuppars, near Radzionkau), Repen (Repten), Ptakowsky (Ptakowitz), and in the communal forest of Beuthen. That the seigneur does not receive more than three parts of the royalty, the fourth part going to the owner of the soil; that in time all the brass foundries, even those at Nuremberg, will have to send to the Low Countries for their calamine, and that actually they could procure it at Beuthen. Breslau paid to Hans Hormig 24 sg. per hundredweight of calamine (being about 1 th. 2 sg. of modern money). We cannot discover for how long a time the working of calamine lasted at Tarnowitz, but it is probable that it was suspended during a tolerably long period under the Emperor Ferdinand II., when, in 1631, the Protestants were driven out of that country, and their churches confiscated.

We notice that David Stillarsky asked on the 15th July for concessions (Muthung), at the Taronowitz office of mines for power to work the calamine on his estates at Styllarzowitz (Stollarzowitz), but it seems that he did nothing after all, and that the concession was not worked.

Starting from the time of the above-mentioned report emanating from the Jægerndorf government, when the extraction of calamine was already in activity, at the end of a hundred and twenty years a new epoch commenced for calamine mining. At the beginning of the 18th century there lived at Breslau one George de Giesche, who had a large fortune, and who possessed a knowledge of mining as well as of business; he travelled for awhile in Silesia, and when he came to the environs of Tarnowitz and Beuthen, he found in the old disused pits a substance which he recognised as calamine, a mineral that had been entirely forgotten, and which was no longer known in the country. He made many experiments and communicated them to the emperor, asking at the same time for a privilege, which he obtained from Leopold, dated at Vienna, 22nd November, 1704, for exclusive power, during twenty years, to work calamine in the whole of Upper and Lower Silesia.

As the extraction of lead and silver was not so actively pushed forward as formerly, and as, consequently, they could not procure the necessary number of miners, he started for Poland and addressed a request to the office of mines for a certain number of miners from the mining town of Ollkusch, and was allowed to bring back with him to Silesia twenty-four mining families, on condition that he returned them if they were needed.

He then began working calamine at Scharlei, near Deutsch-Piekar, at Bobrek, as well as on the estates of Wieschow, on the frontier of Stollarzowitz; he put himself to great expense to fit up his establishment with every requisite, but, as they could not work much at Bobrek on account of the great quantity of water, he was obliged to abandon that position and transfer his miners to the estates at Stallarzowitz on the Wieschow frontier.

It is thus that the mines were able to be worked connectedly, and this gave good results at Scharlei and Stallarzowitz. The calamine was calcined in the country furnaces, and then despatched to the brass manufactories.

For the conveyance of this calamine Giesche made use of the Oder, and as this river is only seven miles distant from the calamine mines, he established a warehouse and wharf on its banks, to which he sent the mineral by carts, and from whence it was forwarded by water as far as Breslau. He deemed Dzieschowitz, about one mile from Leschnitz, the most suitable place for discharging from. He constructed warehouses there, and organized the necessary staff. Even at Breslau he established a counting-house and warehouses to receive the calamine coming by barge.

At the same period one Jacob Fleming established a brass manufactory in Upper Silesia, near Jacobswalde, and drew his calamine from Beuthen.

George de Giesche, guided by his knowledge of commerce, established by means of the Oder, the Elbe, and the Baltic, outlets for business with Sweden and other distant countries.

George de Giesche died, leaving two sons and three daughters. The two sons remained bachelors, the three girls married. Christopher, the elder son, did not live long.

The younger, called after his father George de Giesche, was for long at the head of the firm. At his death the establishment reverted to the heirs of the three daughters.

Both the calamine mines and the house of business have even to this day preserved the business title of "the heirs of George de Giesche."

The Upper Silesia Zinc Mining and Foundry Company.

In 1853, at the time of the business revival in France, some directors of the Vieille-Montagne, a few French and German bankers, and the Count Guido Henckel-Donnersmark, a descendant of the famous Lazarus Henckel, of whom we shall speak further on, founded a company under the title of "The Upper Silesia Zinc Mining and Foundry Company." The aim of this company was to manufacture zinc by working the calamine furnished by the Apfel and Thérèse mines, using for fuel coal from a pit called Ludwigsglück. Other mines, or portions of mines, have been purchased since 1857 from Count Guido Henckel-Donnersmark, and the capital of the company was then doubled. At the present time the company possess either the whole or a greater portion of the following zinc mines:—Cécilia, Wilhelmine, Nouvelle-Hélène and Wilhelms-glück, and the coal-pits Mathilde, Quintoforo, Franz, König Saul, Mercure, Paris, Centrum and Karsten.

After several financial vicissitudes, belonging to non-industrial circumstances which do not properly come within our province, this company has had a period of increasing prosperity ever since the year 1862; once out of the period of foundation and installation, always so costly in the coal and metal industries, it has only now to profit from the expenses incurred in these early days. Thus this same company, which during several years kept back all its profits to employ them in useful improvements, is to-day actually able to pay its dividends in advance.

The cause of this prosperity belongs more especially to a very skilful organization and to the foresight of the directors who were not afraid of spending heavy sums in order to obtain the best and most certain method of extracting the ore from the mines. The methodical use of the neighbouring waters assured a plentiful and good supply for washing the ore, and enabled them to collect a large proportion which was formerly altogether wasted.

Great improvements have been brought, as we shall soon see, to bear upon the construction and conduct of the furnaces. They burn nothing but coal-dust, and they dispose of all that is saleable. The rolling mills are intelligently arranged and require no useless power. The strictest order and economy preside at every operation. In short, the different purposes for which zinc is used are every day increasing, and the commercial organization of the company is at present so thoroughly complete, that its sale of sheet-zinc actually overpasses its production of the raw metal. Last year the company was obliged to purchase 242,450 kilogrammes of raw zinc, and, even then, could not carry out all the orders received.

The following tables, comprising a period of fifteen years, give an exact idea of the progress of the company:—

	1853-54.	1855.	1856.	1857.	1858.
	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.
Extraction of calamine	45,133,650	39,177,900	41,134,250	51,826,800	64,186,750
Extraction of coal	—	—	—	86,257,800	90,080,000
Production of raw zinc	5,534,200	5,350,000	4,202,050	7,324,200	9,134,900
Production of sheet zinc	1,537,550	2,449,950	2,271,000	2,137,550	2,513,500
Sale of sheet zinc	1,349,350	1,994,700	2,277,900	2,282,500	2,340,200

	1859.	1860.	1861.	1862.	1863.
	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.
Extraction of calamine	67,490,300	70,290,600	63,570,150	67,665,650	61,621,650
Extraction of coal	100,103,400	93,205,200	101,356,400	152,192,600	200,620,200
Production of raw zinc	9,880,900	10,593,750	11,926,000	10,873,050	10,297,650
Production of sheet zinc	3,219,600	4,916,450	4,887,700	5,408,400	6,745,000
Sale of sheet zinc	3,198,350	3,571,750	4,920,800	5,853,550	7,818,050

	1864.	1865.	1866.	1867.	1868.
	Kilos.	Kilos.	Kilos.	Kilos.	Kilos.
Extraction of calamine	59,539,300	68,673,350	64,896,400	74,826,400	68,552,500
Extraction of coal	221,016,800	218,205,200	222,778,600	241,181,400	239,902,400
Production of raw zinc	8,280,750	8,291,550	7,592,700	7,354,200	8,105,400
Production of sheet zinc	6,101,450	9,031,450	7,640,450	9,841,650	10,339,850
Sale of sheet zinc	5,530,750	9,565,400	7,509,850	10,007,050	10,550,950

The seat of the company and the centre of commercial operations is at Breslau, the principal establishment at Lipine, near the Morgenroth station, where the line branches off which at Tarnowitz connects the main line of High Silesia with the line from Oppeln to Tarnowitz and the right bank of the Oder; private railways ray off in all directions round Lipine to connect the zinc mines, the coal-pits, and the main railway lines.

The factories being of modern construction, and having been established in a plain, without any restrictions as to space, and without being hampered by previous buildings, have an ampleness of size and a perfection of arrangement which was wanting in those universally famous factories of the Vieille Montagne, which we described on our visit to Angleur.[1] They are placed on each side of the route from Morgenroth to Kœnigshutte, the rolling mills to the south and the foundries to the north. The principal coal-pit, Mathilde, is scarcely two kilometres distant, and the zinc mines some six or eight kilometres.

We paid a visit to Scharlei, one of the most important mines, which, according to a legend, owes its name to a curious episode in the history of mining. Close to this calamine bed, which was then unknown, they discovered in the year 1363 both lead and silver, and a curé named Scarlem came to claim the royalty. The miners, a race not inclined to much long-suffering, refused to pay; the conflict became embittered on both sides, and the curé Scarlem was thrown into Lake Margareth, close to the workings. This murder was punished by the excommunication of both miners and mines, and by the suspension of the work. The name of the curé, scarcely modified at all, still clings to the neighbourhood.

The working is for a great part carried on in the open air, and has much resemblance to that of the slate quarries in Angleur. It is a great circus with gigantic steps on the boundary walls, on which a world of workmen and workwomen are moving and bustling about, carrying the ore in wheel-barrows, and bringing it to the little waggons that run on rails and pass under a short tunnel which conducts them to the raising engine.

The general aspect of the excavation is of a yellow greyish colour, exactly like the aspect of Moresnet. The bed of ore lies obliquely to the soil for a thickness of about 14 metres. The workings in the open air have at the present time reached more than 90 metres in depth. Underground galleries lead in all directions to the extracting pits. As they descend lower the proportion of lead ore mixed with the calamine increases, and this has necessitated many different improvements in separating the ore from the rubble.

The following, according to M. Hugo Solger, préfet of the Beuthen circle, are precise details upon the Silesian calamine and the manner of working:—

Over, says he, what they call the "soil-rock" we meet with calamine, either immediately above this soil, covered by dolomite, and in part by clay, or enclosed in the crevices of the dolomite itself.

Thus calamine is found only in the shell formations, or secondary rock, containing carbonate of oxydized zinc, which is formed in consequence of the chemical transformation of the other component parts of zinc.

They distinguish two kinds—red calamine and white calamine. The white is found almost directly upon the "soil-rock," while the red, in places where it meets the white, is generally found above that.

The difference in colour comes from the presence, more or less marked, of iron-ore; for the rest, these two kinds of calamine have almost the same chemical composition, and are found not only in hard and compact fragments, but even in earthy and friable substances.

These two kinds of calamine are seldom pure; generally they are mixed with clay, especially at places where they touch the calcareous rocks.

In calamine we find a mixture, sometimes very notable, of a white substance, composed of clay and water; this substance is generally of a delicate nature, being friable rather than hard.

[1] See the "Zinc Mine and Zinc Manufactories of the Vieille Montagne," published in No. 9 of the "Practical Magazine."

The calamine beds do not, like the coal beds, appear in the form of a large mass widely spread out, and of regular thickness. They form only in lodes, very limited in all directions, and differing suddenly in value and thickness. These masses and lodes are generally produced by a fault in the soil rock or by crevices more or less extended.

The thickness of the calamine beds is generally greater at the surface than lower down. This fact supports the theory that, from its first foundation, calamine, not being a compact substance, must have been lowered by the dolomite which was above. The most remarkable calamine beds are situated at Scharlei (mines of Scharlei, Wilhelmine, Cecilia, Hélène); in the neighbourhood of Beuthen (mines Thérèse and Apfel); at Miechowitz (mines of Marie, Elizabeth and Emilie)'; at Trockenberg (mines Bescheertglück, Schoris and Trockenberg), some lodes, almost exclusively white calamine, at Gorniki (mines Leopold and Vorsehung), and to the north-east are the mines Planète, Henri and Verona.

The thickness of these beds varies from a few inches to eight lachters—53¼ ft.

The other deposits of calamine found in Silesia form only insignificant kidneys, and are placed round and between the village Radzionkau and the colony Dombrowa.

The work of extracting the calamine is generally very irregular, and can be conducted systematically only in the larger mines.

In the places where the calamine lies directly on the surface, they are able to collect it in the open air. At present there is only one working of this kind, that of the Scharlei mine. The working of calamine is executed almost exclusively under ground.

When the beds can be attacked by a single level they establish a system of galleries as good as possible, but they are only able to collect the calamine by the successive openings of galleries placed one alongside of the other, on account of the heavy pressure of the roof, which does not permit them to remove the walls between the cuttings. As to the beds of zinc ore, which cannot be cut by horizontal galleries, they are compelled, so as to allow the water to run off, and to obtain greater ease in working, to deepen the pits to the lowest level of the calamine, and there to cut out galleries from which they mount by degrees, in zig-zag fashion, to the rock of the topmost roof. Thus, by means of a thorough system of galleries, they are able to collect all the existing ore above or below.

In the coal-pits, on account of the resistance of the rock, they are able to cut pillars of the thickness of four lachters (26⅔ feet), while in the calamine mines they can cut them only from one to one and a half lachters, 6·23 to 10 ft.

On account of the irregularity of the beds and the considerable flow of water, they very rarely get the full thickness of the calamine layers at the first attempt, and so they are constantly obliged to establish new galleries, which considerably increase the cost of working.

The chief obstacles met with in working calamine are the floods of water and the quicksands. In former times the water occasioned many sacrifices, and many useless attempts. It is only in these latter days that the steam-engines have supplied a power sufficient to overcome the heaviest flow of water. Thus to drain all the mines in Scharlei to a depth of 40 lachters (266⅔ ft.), a steam-engine of 450 horse-power has been erected; and, since then, they have been obliged to add two new engines of the same power in order to thoroughly obtain the required end. The calamine mines of the whole circle were in 1853 provided with twenty-nine steam-engines, having a power of 1,293 horses, supplied by eighty-eight boilers.

The second obstacle encountered in working these calamine mines are the quicksands (called kurzawka). This is a sandy and clayey mass impregnated with water, which is often found just above the calamine, and which requires the greatest possible care when they are deepening the pits or constructing the galleries.

This mass, by its nature and its very heavy pressure, is so quick and moveable, that should there be any want of precaucaution in the workings, it would penetrate into the mines through the smallest openings in the wood-work. There is no means of stopping it, and it has already occasioned the death of very many miners.

In Silesia, the calamine mines, like the coal-pits, belong to the state, and can only be conceded by the government. The state does not possess any zinc mines of its own, but retains the hundredth part of all the calamine extracted.

In the circle of Beuthen there are at present 104 calamine mines.

The whole mining field is about 60,698 massen or 20,40·059 morgen = nearly one square mile. The beds of coal and calamine often meet, but in no place up to the present time have they tried to work two mines simultaneously, getting coal from the one and calamine from the other.

On the other hand, the working of calamine and the iron-ores are often united. But the places where coal and calamine lie one under the other are found only in the neighbourhood of the boundary limit where the shell formation is placed above the coal formation.[1]

To prevent the water interfering with the workmen in the immense pit of Scharlei, under the covered galleries they have established gigantic pumping engines, which bring up about 25 cubic metres per minute. This water, which is generally a serious trouble, and which they do not always know how to dispose of, is here a very powerful assistance, and if it had not been necessary to construct a well for its discharge, it would have been essential to establish one, so as to store it by for use. In short, the washing of the ores requires all the water they can draw up, and would, indeed, have employed more if more could be obtained.

This washing establishment is one of the most intelligent arrangements we have ever seen in any industry. Inclined planes raised on open wood-work, and similar to the jetties on a breakwater, come in all directions towards the work-sheds. Up these inclined planes the waggons arrive laden with the ore which has been mechanically raised from the pits. The waggons contain ore to be sifted and washed. Over the other inclined planes the water flows down in a number of streams.

The little waggons holding the ore having arrived at the highest storey of the washing shed, are pushed along the rails into a cage which turns over through its weight, and empties them into a kind of mill-hopper. Below this mill-hopper, a dividing apparatus separates the fragments into three parcels; the large fragments are examined upon an oblique table, where they are sorted by young girls, who place on one side all those containing lead ore; these latter, as well as the pieces which are too large to pass through the washing machine, and which to all appearance contain metals other than calamine, are put into a special box and sent to be re-sorted.

The other fragments which fall from the first dividing machine are received into a strong current of water, in big wrought-iron drums, perforated with holes of different diametres, and there they are classed according to their sizes in various qualities.

It is very important to take away, as much as may be possible, all the particles of lead contained in the sands. One of the best instruments for this operation is the "German chest," at the present day employed in many other industries where it is essential to classify certain substances of different weights. It is composed of boxes open at the top, which are filled with ore, and which receive from below a strong injection of water passing through the bottom which is perforated with little holes.

This water causes the light impurities to rise to the surface, carries the calamine to the middle, and leaves the lead powder at the bottom in a state of almost pure metal. Different dividing apparatus continue this separation of the lead from the calamine, being always based upon the difference in density of the two substances unequally worked by a current of water, or by planes more or less inclined.

One of these instruments consists of a table pivoting upon its centre; it receives the sand in the middle as well as a shower of water regularly injected. A water-shower washes the calamine, and the flow of water and the rotation of the table together lead it by degrees to the edge, and at the circumference it is collected. The lead dust, on the contrary, is maintained by its weight in the centre of the disc, from which it is directly gathered.

They are incessantly endeavouring to improve these processes of sorting and sifting, so to render them more and more economical. All the water which has been used for washing purposes is received in pipes, and flows into a series of basins to deposit there any calamine which it may have taken along with it. Should there be any lead, the weight naturally carries it to the bottom of the basin. They are thus able to gather up the slightest fraction of zinc ore, the lead being separately treated.

The other calamine workings have all their arrangements for washing and sorting, similar to those at Scharlei. It is from this place that the waggons laden with all ores belonging to the company are despatched to Lipine.

The coal-pits, in the same way, are worked on a thoroughly well understood system of economy. Mathilde, which is the nearest to the furnaces, is provided with sorting arrangements similar to those we saw at work at Creusot.

Coming from the shaft, waggons are pushed into a circular cage which turns them over, a process preferable to the old plan of upsetting them directly, which required the waggons to be much more solidly constructed.

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[1] Hugo Solger, "Le cercle de Beuthen."

By means of gratings, finer or coarser, leaning upon inclined planes, the division into different qualities is effected. Almost all the lump coal that is transportable, is sold for the benefit of the company, and the works themselves are carried on with the small coal-dust, and the inferior qualities which have no trade demand; waggons placed under the gratings receive the classified coal and bear it to its destination. This arrangement allowed them to sell in the year 1866, 112,000 tons of trade coal at 6 fr. 02 c., and the company purchased for its own wants 72,000 tons of small coal at 2 fr. 97 c. There has thus been the very noteworthy profit of 3 fr. 5 c. per ton, or in all, 219,000 fr. To push this economy to its last limits, they have established a system of washing, so as to extract the scoriæ from the furnaces, and to utilize all the coal which has escaped combustion, and this plan represents a further saving of 10 per cent. on the whole coal employed.

The reducing furnaces are placed in blocks, back to back, in a straight line, occupying the central parts of the large halls, known as Silesia number I., Silesia number II., and Silesia number III. The first contains twenty furnaces; the second and third sixteen each. The heating system of these furnaces has just been very advantageously improved since the adoption of the Siemens furnace, more or less modified for glass works, gas works, and a great many other industries. Much attention has been bestowed upon the means of bringing to the exact point where intense heat is essential those combustible gases from wood or from coal, and not wasting them as formerly, by a combustion distant from the point, but, on the contrary, preserving all their fuel qualities.

Instead of uselessly heating the blocks of bricks as was formerly done, they have been led to work a kind of distillation and incomplete oxidation out of the coal, and instead of carbonic acid they have produced carburetted hydrogen gas and oxide of carbon, which is arranged so as to burn exactly under the crucible or the retort. They thus not only obtain a thorough utilization of the combustible, but they get the intensity of the fire at the place desired, since it is at this point only that the rapid oxidation takes place.

M. Schneider, director of the company, has applied this new theory in the most happy fashion by introducing a draught of hot air, which meets the combustible gases at a certain distance from their generators. As the distillation and the incomplete combustion can be effected only if the coal is heaped up so as to diminish the draught as much as possible, very small coal and coal-dust are better for the purpose than lump coal, into which the air would penetrate too slowly. The laying or charging of these furnaces of M. Schneider is very easily conducted from the outside of the buildings, where the gases, circulating in an interior system of tubes, are burnt in the furnaces directly under the retorts.

M. Schneider, by these different arrangements, has effected an important economy, which may be estimated at a saving of 440,000 thalers annually or 825,000 francs.

Calamine coming from the Thérèse mines contains :—

Carbonate of zinc	23·21
Silicate of zinc oxide	5·34
Oxide of iron	36·72
Alumina and silica	20·81
Water	13·24

Calamine coming from the Cécilie mines contains :—

Carbonate of zinc	38·42
Silicate of zinc oxide	2·89
Oxide of iron	24·34
Lime	4·36
Alumina and silica	14·02
Water	15·20
Lead, sulphur, and cadmium	traces.

Calamine from the Scharlei mines contain :—

Carbonate of zinc	35·26
Silica	7·84
Sulphate of lead	1·23
Oxide of iron	10·23
Lime	14·27
Alumina and silica	12·95
Water	18·14

The richest lump calamine may contain, according to the analysis, as much as 45 per cent. metal. The poorest calamine, such as that known as schlamm, &c., from 9 to 6 per cent. calamine, generally contains 0·25 per cent. of lead, but in the calamine received from the mines they often meet with pieces containing lead in a much higher proportion. Some few lumps of lead-ore are withdrawn by hand when they are putting the calamine into the furnaces.

Calamine, being a compound of carbonate and oxide of zinc mixed with silica and alumina, it is sufficient to free the metal to heat it to a high temperature with a quantity of lump coals, which serves as a reducer, but, as the ore is hydrated in a rather strong proportion, it is necessary to calcine it so as to eliminate the water and the carbonic acid, by rendering the calamine more friable and easier to pulverize.

Calcination takes place in different apparatus according to the size of the fragments—the dust-ore being calcined in the reverberatory furnaces, the large lump in furnaces charged at the top and discharged at the bottom. The ore is placed in layers alternating with small coal, the heat should be managed in such a manner as not to reduce the metal and not to volatilize the zinc.

This metal becomes volatile at a white heat, and has such an affinity for the oxygen in the air that it immediately flames up, falling down again in white oxide under the form of flakes, termed by the ancient chemists *lana philosophica;* it is necessary, then, to effect the reduction in closed vessels. These Silesian muffles are closed at their anterior opening which is penetrated by an adjustage swelling out below the middle part, there the reduced zinc deposits itself; the adjustage itself being terminated by a wrought-iron bulb which receives the oxide of zinc, all the interstices having first been carefully plastered up with clay.

The muffles are placed, two by two, in furnaces with an elliptical roof, similar to those in the glass furnaces. The charge is composed of two-thirds of crushed calamine and of one-third of small coke or coal-dust. The muffles are charged every four-and-twenty hours, for the Silesian calamines, being more easily reducible than the Belgian calamines, do not require more than this time before they yield their metal.

At the moment of charging there is again a waste of the oxide of zinc in spite of all the precautions employed to shorten the time during which the muffles are obliged to remain open as much as possible.

Every four-and-twenty hours they take out the metal deposited in the cavity and the adjustage, and pour it into cast-iron moulds bearing the brand of each furnace; thus it is easy to check the quantity and the quality of the productions of this or that group of workmen. Then, as hastily as possible, the furnace is charged anew, all the openings being speedily plastered up with moist clay.

These operations are executed with ladles, tongs and other tools, hafted with handles more than three metres long, all of which the workmen manage with great dexterity. They are obliged to be careful, at the moment of charging, not to face the opening of the adjustage, for the little water added, so as to mix the ore and the coal, occasions a sudden formation of steam, which drives the flaming gases out with the greatest violence; the workmen are also interested in allowing as little waste as may be, for they are paid according to the weight of metal produced.

They incessantly examine the condition of their muffles, plastering and replastering them with clay to stop up the fissures through which the volatilized zinc would escape, and, going to the summit of the chimneys, would burn away in white oxide. At the end of some fifteen days they are obliged to change the adjustage, in which a deposit of metal has gradually formed, till the passage is blocked up, and they are unable to insert their ladles and scrapers. The zinc they draw out, after having broken the coating-scum, is treated in successive operations. The greater or lesser quantity of waste depends upon the solidity of the muffles, and it is of the highest importance to have them constructed in a first-class manner.

The building of the furnaces and the manufacture of the retorts have necessitated the establishment of separate workshops for the manufacture of fire-proof products; this establishment in itself must needs be a most important one; from it they turn out the necessary number of the great Silesian retorts, almost as large as gas-retorts, besides a vast quantity of fire-bricks and furnace-pieces.

The substances employed are, as in all analogous establishments, the *débris* of the products which have been already used, and these are broken up and reduced to a fine powder, which, in the French manufactories, is termed cement. The fire-clays are of two kinds; the white clays coming from Mirow, in Poland, the darker clays from Neukirch, in Silesia. These clays are desiccated in the dryers, and are then pulverized in vertical mills; three kinds of powdered matter are mixed together—about one-half of cement and one-fourth each of the new clays; the mixture is kneaded in a cylinder in which a helix is worked, which compresses the paste and forces it out, when ready, through the lower part.

Many experiments have been made with a view to the mechanical production of the retorts, but up to the present they

have not yielded results sufficiently satisfactory to justify them in abandoning the old sytem of moulding, which is effected by pressing the clay, in a whole series of operations, upon wooden moulds. The retorts or muffles are straight and flat in the lower part, rounded and smooth at the upper; they are about 1 metre 50 centimetres long, by 80 centimetres high and 25 broad; the walls are 3 centimetres, more or less, in thickness; and they have a resisting power which could last six weeks. The "stock," which always contains a large number of these retorts, is ranged in immense drying sheds with three floors, each more than 140 metres long.

The retorts remain there until they are thoroughly dried, and then they are baked in the same furnaces in which they will eventually be employed.

The furnace-pieces are moulded in a cast-iron box, and undergo a strong pressure by the elevation of a hinged jamb under the power of an hydraulic press of 200 tons. Thus they are made with thorough neatness and perfection, their surface being as smooth and polished as soap. Each moulding machine can turn out about 100 furnace-pieces per diem; they are not, like the retorts, placed in their unbaked state in the furnace where they are afterwards to be used, but are baked in the cupola furnaces.

The products of combustion escape through an opening cut in the roof, which communicates with chimneys a metre in height. These openings serve at the same time to regulate the draught of the furnaces. These furnaces possess the advantage of being able to use small coal to obtain their necessary degree of heat, and to ensure the perfect baking of all their contents.

The brick-works occupy about eighty persons.

On an average, 100 kilogrammes of ore yield 14 of metal. Were the operation performed in a vessel closed from the outer air, 15½ could be obtained, and they have still to discover the means of saving the quantity of from 1 to 1½ per cent. of metal that is now burnt or wasted.

The metallic dust and powder collected contains a very heavy proportion of metal, which is extracted by the Montefiore process. This process consists in bringing the particles, placed in a heated upright cylinder, to 500° of heat, and then facilitating the condensation of the metal by compressing the charge by means of a piston fitted with a steel rod, which is attached to the cylinder. The fire is made as hot and brisk as possible, and at 2½ hours from starting point, they pass a small bradawl some centimetres long, through the clay plug which closes the lowest part of the cylinder, and the metal is collected in a vessel heated beforehand; then, with a little rod of flexible iron, the workman agitates the mass and stirs it about; at the same time he rests his whole weight upon the moveable iron, penetrating into the cylinder, and thus he obtains a fresh flow of the metal. When as much as 80 per cent. of the zinc contained in the slag has been extracted, he stops the operation, and treats the residuum in the ordinary reducing furnaces.

In 1868, the various furnaces produced:—

Silesia	I. . . .	1,128,250 kilogrammes
„	II. . .	3,446,250 „
„	III. . .	3,530,900 „
	Total . .	8,105,400 kilogrammes.

No raw zinc is sold at Lipine, and all the metal made in the form of slabs of about 10 kilogrammes each, is carried to the rolling mills. The company possesses three rolling mills; two worked by water, one at Ohlau with four pairs of cylinders, the other at Jedlitz, near Malapane, with one pair; the third rolling mill is the largest; it is situated at Lipine itself, and its eight pairs of cylinders are worked by steam. This establishment is very intelligently organized as to its large halls or sheds, where every manner of work can be executed with the greatest ease; the most perfect order reigns everywhere, and exhibits a thoroughly well-arranged connection between the steam-engines and the rolling-mill. Instead of uniting all the power in one single machine, the force has been so divided that each rolling-mill is attached to its independent engine, and thus the stoppage of an engine or a rolling-mill does not suspend the work of the other engines. Each engine is about 120 horse-power; they are all placed in a line in a gallery parallel to the rolling shed, and receive the steam from a battery of thirty boilers, each having a heating surface of about 40 metres.

The rolling-mills in the same way are placed in line along the wall, separating the shed from the gallery, so that the power may be transmitted as directly as can be.

It is not possible to roll the slabs just as they arrive from the foundries, for they still contain a quantity of lead sufficient to affect the quality of the zinc, and it is hard to separate the two. To obtain this result, the raw zinc is melted in the furnaces invented by M. Schneider; the temperature is maintained at about 150°, and the hearth is arranged in such a manner that the lead, which is the heaviest, is deposited in an inclined corner, from which it is gathered every six months. The heat ought to be gently managed so as to produce as little oxide as possible; nevertheless, there is still a loss of 1 per cent.

The molten metal is poured into moulds, and formed into slabs of about one centimetre in thickness, and these, before they have had time to cool, are immediately passed to the rolling-mills. As in all rolling-mills, a workman placed in front of the mill, puts the slab or plate between the two cylinders, and a workman standing behind returns it to him by passing it above the upper cylinder. When the plates have been sufficiently reduced in thickness, they are passed again by pairs, by fours, sometimes even as much as by twenties—all the plates being similar—until they are made into sheets of the desired thickness.

The manufacture of zinc sheets requires a considerable power, and cylinders of extreme hardness and resistance; the cylinders employed at Lipine are of English white iron tempered. In spite of the tenacity of the metal, and the diameter of the cylinder they are sometimes broken; not, however, nearly so often since the makers have given a certain mobility to the upper cylinder, by maintaining its axle by a balance, instead of fixing it by a rigid plummer-block. If the resistance of the zinc is stronger than the power endeavouring to roll it, at the moment when, according to the ancient system, the cylinder would be shattered, the axle is now slightly raised, and returns to its place through the action of the balancing weight.

The sheets, thinned a first time in the preparatory rolling-mills, are carried to the tables, where they are squared by means of grinding rods and large scissors. The plates thus trimmed are reheated in an annealing furnace, then passed through the finishing rolling-mills; they are after this trimmed again, and brought to the usual trade sizes by circular cutters, acting parallel to a horizontal table. On the same table they are stamped with a brand indicating the place of manufacture, and the number of the sheet.

The squared sheets are despatched to a warehouse, where they are classed, sorted, and examined with a very minute care; the slightest flaw condemns the sheet to the melting furnaces; and the examination is so strict that about 3 per cent. of the total production are rejected, although the trade would have purchased them readily enough. The least flaw or scratch, or any fault in the surface polish, suffices to condemn them, as does also a difference more or less in weight, for the tolerance of the examiners is not allowed to overpass a two-thousandth part of the regulated weight. It often happens that the flaw does not cover the entire sheet; they then cut off only the part rejected, and reserve the rest to be made into roofing bands, or to be sold as sheets of smaller dimensions for use in making kitchen utensils, and for other purposes.

The establishment at Lipine produces nothing but sheet zinc, and leaves private industry the whole labour of adapting it to the purposes of trade; contrary, however, to this principle the society has started a machine for fluting the sheets for roofing. Some few years ago it was supposed that a sheet of fluted zinc would acquire such a rigidity that, if it would not absolutely do without supports, it would only require resting places at rare intervals. Upon this principle a whole system of roofing was based; but the fluting augmented the surface and the price of the metal in such a proportion that the saving resulting from the diminution of supports was counterbalanced; nevertheless, as there are many circumstances in which the erection of a roof very lightly placed and as speedily constructed as possible might be extremely useful, the manufacture of this fluted zinc has always been continued. The roofs thus made have a regular appearance, very pleasing to the eye. The production of sheet zinc was in 1868, 10,339,860 kilogrammes; in 1853, it was 1,537,550.

As the trade of the company is often carried on with distant countries, even with those across the Mediterranean, and on the other side of the Atlantic, the packing of the zinc sheets requires particular care. The rolled sheets are placed in solid barrels, so as to preserve them from any injurious shocks; when the sheets are intended to go by sea, they are packed in a large wooden puncheon or tun lined with another band of zinc sheets, carefully soldered together, so as to hinder the penetration of the salt and humid air.

The manufacture of these wooden tuns or puncheons has necessitated the establishment of a factory, fitted with all the most perfect wood-working machines.

The staves are made of thick fir, bound together by birch hoops and a few iron hoops; the wood, after having been cut into planks by vertical saws, and cut into lengths by circular saws, is rounded, smoothed, and curved in one single planing machine. So as to make them all fit as well as possible, it is necessary that each stave should be laterally terminated by an

oblique surface, calculated according to the radius going to the centre of the barrel, so that the exterior side should be larger than the interior, and that each of these surfaces joined to those of the other staves, should form two absolutely concentric circles.

This result is obtained mechanically by fixing the wooden plank in a moveable vice, which directs the stave towards two circular saws placed obliquely, so that the intersection of their plane forms the exact angle which would be produced to the centre of the barrel if we prolonged the two lateral surfaces of the stave made by the passage of the saws. These pieces of wood being all identical, are collected in a circular frame of iron, where they are bound by birch hoops. However well made they may be, these puncheons would require many after-touches before they would hold water; they are, however, sufficiently air-tight to preserve the metal against all outer contact. A stock of about 5,000 of these barrels is constantly kept on hand for the foreign trade to the East or to America.

If the zinc sheets are sent by sea, the wooden barrels are lined with zinc. The sheets despatched to Peru and which, crossing the Cordilleras, have to travel by land, are packed in little barrels of from one to two hundredweight, so as to be loaded on the back of a mule. Those intended for Europe are packed flaty in wooden boxes or cases.

The company employs a large number of hands in its coal-pits, its zinc mines, its furnaces, and its rolling-mills; a great proportion of them are of Polish origin. The company, so as to retain the best, selected from among the steadiest and hardest working those who could be trusted with 100 thalers worth of land, and the bricks and wood necessary for building a house, giving them ample time to reimburse the advances easily. The houses built by the workmen generally include, in addition to their own rooms, apartments which they let out to their comrades, and the return from the rent of these amounts to more than the yearly sum they have to pay the company; so in a few years they become, almost without any personal expenditure, the owners of their houses; if they quit the country before they have paid off all the annuities due, the houses lapse to the company. It also reserves the right of preference if a workman wishes to sell the house he has acquired.

Relief funds and supply associations are encouraged by the company; the schools, too, were founded at its expense.

The tables in the foregoing column show the sale of sheet-zinc to the different countries of the world from the foundation of the company to the year 1868.

Names of the Countries.	1855.		1856.		1857.		1858.		1859.	
Prussia	11,439	52	20,141	64	25,125	95	24,469	52	19,692	83
Saxony	2,360	16	4,727	15	5,301	68	5,715	60	6,012	74
Bavaria	—	—	—	—	—	—	721	22	1,436	17
Wurtemberg	—	—	1	31	—	68	—	—	—	—
Baden	—	—	—	—	—	—	—	—	—	—
Brunswick	—	—	—	—	493	25	625	11	1,192	88
Oldenburg	—	—	—	—	—	—	—	—	140	—
The other German principalities	—	—	—	—	—	—	141	69	—	48
The Custom House Union of Germany	13,799	68	24,870	10	30,921	56	31,673	14	28,475	10
Hanseatic Towns	—	—	3,140	67	5,436	60	2,806	97	5,673	33
Mecklenburg & Holstein	—	—	4	81	3	38	—	—	130	—
Austria	1,304	90	4,591	80	5,933	99	6,860	59	4,173	32
Denmark	—	—	509	—	1,960	—	1,895	—	2,266	67
Sweden and Norway	—	—	304	—	1,202	13	982	42	1,440	—
Russia	—	—	—	—	—	—	400	—	544	28
Danubian Principalities	—	—	—	—	826	—	1,275	—	515	20
Holland	—	—	—	—	—	—	—	—	—	—
Italy	—	—	—	—	—	—	—	—	—	—
Switzerland	—	—	—	—	—	—	—	—	—	—
England	—	—	—	—	1,107	45	157	48	8,474	36
France	—	—	—	—	—	—	—	—	—	—
America	—	—	—	—	442	56	1,020	08	12,094	33
India	—	—	—	—	—	—	—	—	—	—

Names of the Countries.	1860.		1861.		1862.		1863.		1864.	
Prussia	22,109	54	39,727	85	50,388	39	66,078	22	57 063	99½
Saxony	8,580	20	9,251	84	11,238	—	11,755	41	9,924	32
Bavaria	1,760	—	2,600	86	3,756	13	4,118	80	838	38
Wurtemberg	—	—	55	—	—	—	30	—	—	—
Baden	—	—	—	—	—	—	—	—	—	—
Brunswick	723	—	791	21	860	—	775	—	565	—
Oldenburg	220	—	245	—	350	—	605	—	250	—
The other German Principalities	25	—	545	—		—	1,765	73	1,988	50
The Custom House Union of Germany	33.417	74	53.216	76	67,098	52	85,128	16	70,630	19½
Hanseatic Towns	5,003	14	9,414	50	12,649	12	11,737	09	7,111	11
Mecklenburg & Holstein	—	—	110	—	45	—	41	—	184	—
Austria	8,565	68	8,966	09	10,647	81	9,043	53	2,199	85
Denmark	2,220	—	1,881	55	1,929	06	2,018	—	1,638	29
Sweden and Norway	1,495	—	1,715	—	1,540	—	1,715	50	1,590	—
Russia	772	65	1,067	20	1,468	09	1,354	80	240	—
Danubian Principalities	1,734	60	1,101	—	123	20	439	42	792	62½
Holland	—	—	355	50	2,774	85	4,130	54	3,264	63
Italy	155	—	2,221	67	47	—	37	—	21	—
Switzerland	—	—	—	—	—	—	4	89	—	—
England	18,122	65	8,195	20	11,678	58	39,717	32	21,462	31
France	—	—	—	—	—	—	—	—	—	—
America	—	—	8,732	92	5,662	92	818	64	924	50
India	4	91	1,348	05	1,396	65½	174	87½	64	41

Names of the Countries.	1865.		1866.		1867.		1868.	
Prussia	93,424	91	67,308	20½	102,129	27	100,989	56
Saxony	16,791	18	12,225	43	18,444	90	16,769	37
Bavaria	2,454	80	1,642	89	5,394	31	6,501	71
Wurtemberg	—	—	—	—	439	96	112	57
Baden	—	—	—	—	1,738	72	6,101	28
Brunswick	917	65	300	—	871	45	1,322	83
Oldenburg	300	—	338	38	300	—	503	41
The other German Principalities	1,200	98	995	—	1,824	85	1,726	37
The Custom House Union of Germany	115,089	52	82,809	90½	131,143	46	134,027	10
Hanseatic Towns	10,431	91	14,385	70	13,767	53	11,010	59
Mecklenburg and Holstein	566	44	477	—	230	—	185	—
Austria	36	25	39	67	341	09	115	21
Denmark	2,233	28	3,739	82	3,587	56	2,964	93
Sweden and Norway	2,285	—	1,830	—	2,260	78	2,185	—
Russia	1,285	48	1,023	—	1,163	—	1,488	11
Danubian Principalities	525	—	20	—	205	—	115	—
Holland	5,206	02	4,094	68	5,307	67	9,868	73
Italy	49	—	—	—	—	—	—	—
Switzerland	—	—	—	—	462	38	906	60
England	39,719	84	41,695	41	41,426	14	44,837	79
France	—	—	—	—	2	10	—	—
America	13,880	—	81	60	244	30	3,315	23
India	—	—	—	—	—	—	—	—

FRIEDERICHS-HUTTE.

Friderichs-Hütte, the largest of the factories for the manufacture of the argentiferous lead ore, which formerly gave the Beuthen circle such a metallurgical celebrity, belongs to the Prussian Government, and is managed by the engineers of the royal administration. It is supplied by the ores coming from the vast field reserved by Frederick the Great; but in addition to these, the ores purchased from different proprietors are also treated. The precise date at which they began to work lead and silver in this district, is indicated by none of the authors whose works we have looked over.

M. Hugo Solger alone believes that towards the year 1230, this industry was already flourishing because a Presbytery was then established at Beuthen, and because they surrounded the town with walls, neither of which things would, he urges, have been done in a poor country without commerce and without products. The dispute preceding the death of the curé Scarlem, in 1363, certainly indicates that the extraction of these metals was in full operation at that time.

The sovereignty of the country then belonged to the Dukes of Teschen,[1] who exchanged it, in 1470, with King Mathias, of Hungary, for the Duchy of Kosel. This sovereign, for a loan of 8,000 ducats in 1477, gave the country of Beuthen to one Hans Zierotin, who ceded his pledge in 1498 to Duke Johann, of Oppeln. At the death of this latter, in 1532, the Duchy became the possession of the Marquis George Brandenburg, of Onolzbach, who ceded it to his son George Frederick, in 1543. The Brandenburg family thoroughly protected the mines and miners. Since the year 1526, the whole of the lead industry in Silesia was situated around Tarnowitz, when it prospered in spite of a swarm of difficulties coming from the immense quantity of water. It was about the beginning of the sixteenth century[2] that an enterprise, more important than any other for the progress of the lead mines was carried into execution; this was the opening of the Jacob draining shafts, near Lowitz, close to the town of Tarnowitz, the whole being constructed by the miners. In the space of forty years, these works cost 200,000 thalers of actual money, an enormous sum for the time, and one that not only suggests the great difficulties of the undertaking, but also the rich nature of the mining field, the draining of which was prosecuted with such perseverance.

At this period they gathered in certain years as much as 20,000 cwts. of lead ore. The working was chiefly carried on near Bobrownik and Rudy Piekar, close to Repten, Silberberg, &c.

The ground the operations cover extends for about one million square lachters; and supposing only that one-fourth part has been really worked and exhausted, and allowing, as a fair aver-

[1] Steinbeck,' Geschichte des schlesischen Bergbaues, part ii., page 138.

[2] Der Strebebau auf der Friederichs Bleicz-Grube bei Tarnowitz. Prussian Journal of Mines, 1853.

THE LIPINE ROL

IE ROLLING MILLS.

age return, 10 cwt. of ore, and one loth of silver per cwt. of lead ore per square lachter, we have the following result; about one and a half million cwt. of lead or litharge, plus, at the least, 150,000 marks of silver.[1]

It is even probable that the production has been more than the amount above stated.

A powerful impulse was given to the prosperity of the mines by the prince-elector, George Brandenburg, and by his son George Frederick who succeeded him; this latter twice visited Tarnowitz personally (in 1550, and 1561). Both sovereigns promulgated most sagacious ordinances for the mines, taking themselves an active interest in the construction of many draining shafts and galleries, aiding the partners by means of cash advances, and the remission of imposts and taxes, sending workmen from Franconia (Onolzbach, Gold-Kronach, &c.), and granting wood gratis to all the mines and foundries.

In 1544, thirteen factories were in full activity; in 1556, the plague carried off a large number of workmen; but in 1559, a very important sale of litharge revived the prosperity of the country. In 1561, they collected 13,300 cwt. of lead or litharge, and 4,340 marks, and 3 loth of silver. To George Frederick succeeded Joachim Frederick Brandenburg, who gave Beuthen to his son Johann George. This margrave continued the traditions of the family, and visited Tarnowitz in 1608; in 1618, the great law-suit was decided which delivered the district of Beuthen over to the Brandenburg family.

By a judgment of the 17th May of this year, Johann George was condemned to lose his rights of sovereignty in Silesia; on the other hand they restored to him the 8,000 ducats, the original loan of Hans de Zierotin, plus the cost of all the improvements executed. By this decision, the property of the Duchy returned to the crown.

Johann George de Brandenburg not only refused to submit to this judgment, but defended his rights by force of arms. He allied himself with that Frederick, King of Bohemia, who was elected by the Protestant party. After the defeat he was excluded from the amnesty, and his property in Silesia was confiscated.

Even before the matter had been decided by arms, the Emperor Ferdinand II. had, on 26th June, 1618, for an advance pledged Beuthen and Oderberg, to Lazarus Henckel the senior lord of Donnersmarck; consequently, and as owner of the debt of 1623, Lazarus Henckel transferred them for the sum of 50,000 florins to the heirs of Count Carl de Harrach, to whom the Emperor had made a gift of the real property.

After the death of Lazarus Henckel, in 1624, the Emperor Ferdinand II., by letters patent, dated from Vienna, on 26th May, 1629, sold this debt, with many important privileges, to the son of Lazarus Henckel.

The eldest member of this family, Lazarus Henckel Donnersmark (M. de Gfell and Wesendorf), had been councillor and general director of all the mines of the kingdom. This explains how he was led to the acquisition of the duchy. The mining sounding-rod which is found on the escutcheon of Count Henckel's family, preserves the memory of this intelligent and active ancestor.

The act of sale speaks, among other things, of forges, mines, and all kinds of metals and ores; to this is added that on account of the decay of the mines and the expenses to which he had been put for so many years by his attempts to revive them, he and his three sons Elias, Gabriel, and George Frederick would be held exempt, during the term of their lives, from all payment of any royalties and levies.

In 1671, after the death of the four persons exempt from the inposts, this exemption was, on the 10th July, 1677, once more granted by the Emperor Leopold I. to the two sons of Count George Frederick, who bore the names of Leo Ferdinand and Carl Maximilian, for the terms of their natural lives.

At the death of the first, his son and his brother, as well as the sons of the latter, requested a new extension of this privilege, but in vain, and in 1729 the treasury received orders to institute legal proceedings against Count Henckel because he refused to pay the royalty.

This lawsuit lasted up to the year 1750, and the decision of the 14th of July regulated all connections with the royal chest. Since then the lordship of Beuthen has remained in the family of Count Henckel Donnersmarck, who was raised on the 14th November, 1697, to the rank of Seigneurie, and to the honours, privileges, and rights of the Silesian nobility.

In 1624 the new proprietor had taken steps to revive the mines, but, in 1628, a persecution against the Protestants, a party very numerous and very industrious, almost ruined the whole undertaking. Starting from 1630, we scarcely find any historical traces of the metallurgical industries, and even these data are nothing but complaints and petitions. The workers complained of the insufficiency of necessary means to give some impulse to their labours, and they asked for more liberty in the sale of silver.

The end of the seventeenth century and the beginning of the eighteenth were so little favourable to the Tarnowitz factories, that in 1746 not more than a dozen persons remained in the works. It was reserved to the descendants of the Prince of Brandenburg to recall these mines to life.

Under the reign of Frederick the Great, the workings had been renewed, and on the 16th July, 1784,[1] the first ore was extracted from the Rodolphine pit—there is a monument which still recalls the event.

The continuation of this pit led to the discovery of tolerably rich seams, but they had to struggle much against the heavy quantity of water, all means to conquer it being at that time insufficient. It was only with the assistance of the steam-engine that they were at last able to draw the fields of ore. This permitted them to cut the Gottshelf Gallery and to construct, in 1806, a through system of deep galleries to receive the whole flow of water (five to seven hundred cubic feet of water per minute) at a given point, from whence a single engine conducted it to the Gottshelf Gallery (22 ft. high). The first steam-engine imported from England was at work in 1788, some years later the factory of Gleiwitz, only just started, turned out similar engines of much larger dimensions.

Under the name of Friederichs-Grube (Frederick Mine) they include the whole extent of the workings of lead-ore around Tarnowitz carried on on account of the state to the north of this town as far as the valley of the Stola, near Sowitz, to the south as far as the Trockenberg, Silberberg, and Sau Garten.

This field is three-quarters of a mile long, and from 300 to 700 lachters broad.

It has been divided into four districts, from north to south,

The Pit District, so named after the Gottshelf pit, which is found there.

The Town District, from the east to the south, in the neighbourhood of the town.

The Bolrownik district, to the south of the preceding district, and spreading towards the south.

The Trockenberg District.

The state has, nevertheless, reserved a much larger field for the working of lead ore, the limits of which, according to the royal decree of the 20th October, 1837, are thus arranged:—

From Piasetzna, situated in the Stola Valley, as far as Naklo, passing by Lassowitz; from there by Orzech, Koslowagura, to the hill near Josephsdorf; further on, as far as the Brinice (forming the frontier of the country), descending to Kamin; from there in a straight line, by Beuthen to Schomberg, then also in a straight line, as far as Bobrek farm, and to the middle of the village of Biskupitz; starting from thence, in a straight line, to the midst of Ptakowitz, and a straight line passing by Rybna, and returning to the starting point.

No permission to seek for lead-ores in this field has ever been accorded, and in cases where the syndicates for working calamine or iron have gathered lead-ore, they are obliged to restore it to the Frederick Mine upon payment of the cost of working.

Outside of the actual Frederick Mine fields, there have not, as yet, been many investigations undertaken on the account of the state; and, with the exception of some few rich seams which they came upon at Miechowitz, these attempts have not produced any great results. On the other hand, the works undertaken for the discovery of calamine have brought to light many beds of very rich lead-ore.

The exterior surface of a mining-field has the appearance of a slightly undulated estate. The highest elevations are situated to the south, and are called the Trockenberg and the Silberberg.

From this first-named mountain a plateau descends to the north-east and the north towards Nacklo and Lassowitz, while from the Silberberg the plateau is directed by the Saugarten towards the north-east; from Neurepten, as far as the Bergfreiheit colony, also towards the north, terminating in the Stola Valley. Between these two plains the Plockza Valley is situated on a gentle slope; to the right of the bottom of the valley we find the villages of Bobrownik and Rudypiekar; to the left, a quarter of a mile lower down, the town of Tarnowitz.

On the western border of the western plain we find two valleys, Alt-Repten and Alt-Tarnowitz. The two quickly unite.

The principal valley of the Drama flows in a south-westerly

[1] 1 mark = 16 loths = 288 grains, or 1 loth = 18 grains.

[1] "Journal des Mines."

direction by Broslawitz, Kamienitz, &c., towards Peiskretscham, where it throws itself into the Klodnitz.

In the neighbourhood of the junction of these valleys above Broslawitz is situated the Frederick Pit, which receives all the water of the entire field of the Frederick Mine.

This pit is 5 lachters, 22 inches deeper than the Gottshelf Pit (in the Stala Valley), and 7 lachters, 59 inches deeper than the Jacob Pit, established in the sixteenth century, near Lowitz. The surface of the Frederick Pit is 857 French feet above the level of the sea.

The soil rock at Frederick Pit is a lias generally very compact, &c., of an azure blue colour, termed by the miners blue soil rock.[1]

This lias lies generally in very thin beds. In some few thicker places, it is compose of crystallized grains, but it is more often similar to slate. These two formations cross each other alternately in layers that generally undulate.

The petrifactions met with in this rock allow us, without any doubt, to fix the age of the formation, and to attribute it to the lias shell formation. Starting from Trockenberg and the upper boundary of Rudypiekar, the soil rock crops up altogether in the open air, and upon a smaller scale upon the heights between this last village (Rudypiekar), and Naklo, as well as in the valley of the Stola, between Lassowitz and Lowitz. From that point the rock sinks in gentle undulations towards the east. The dip is very slight in the northern portion of the field ; and, on the contrary, very sharp in the southern portion. At intervals we find escarpments of one, two, and even three lachters in height.

While this rock attains at Lowitz a depth of ten lachters (in the town of Tarnowitz, as well as at Bolrownik, it is from 12 to 15 lachters), we never find it in the pits situated to the east at a less depth than from 27 to 28 lachters.

In the southern portion of the field this depth is as much as 33 lachters on account of the changes of the surface-soil. At the foot of the Silberberg to the south, the rock lies in the open air, and if we go towards the west we find at a very slight depth the blue soil rock in the calamine mines of Bescheertfreude, Verona, &c., situated in the neighbourhood.

Often the soil-rock is covered with sand and clay, sometimes with these two substances mixed, sometimes separated in beds of a very irregular formation, in which we meet the quicksand (kursawka), which is so much dreaded on account of its constant condition of instability.

The dolomite appears in the open air to the west of the town, and the soil-rock to the east ; the surface of these two rocks forms here a kind of united heap, covered with clay and sand, through which, almost through the middle, the valley of Ploczka descends.

At the southern end of this valley, the thickness of the covering sensibly diminishes, and at the two sides of the valley, as well as to the south, the dolomite appears bare and free.

All the way from Trockenberg to the southern foot of Silberberg we do not meet with this covering, or, at all events, meet it in very small proportions. At this place the dolomite becomes much thicker. The thickness increases still further between the Rabe and Fuchs pits, where it attains 30 lachters.

Dolomite is distinguished from the lias by its fine grained layers, its glittering fractures, its hardness and very heavy weight. The newly extracted stone, which has not yet been submitted to atmospheric influences, is of an ashy colour, slightly tinged with blue.[2]

The grey colour is often changed, especially in the crevices, into yellow or yellowish brown. These colours sometimes cross the whole of the rock, and this indicates the presence of oxide of iron ; the tint is sometimes modified to even black-brown, often the exterior of the dolomite appears below while the interior is compact and unaltered. Often, too, it has no cohesion and may be broken by the fingers. It is in the dolomite placed above the blue soil rock that the lead ore is found.

The galena of Friederichsgrube, containing from ¾ to 1 loth of silver per hundredweight, is often met with in the cavities of the dolomite. In other places the ore forms a compact bed of from ½ in. to 12 in., and even more in thickness.

In general the thickness of the ore measures from 10 to 20 inches, sometimes as much as a lachter.

The lead ore divides the dolomite into two divisions ; the portion situated below the ore is termed by the miners "brown ground rock," and the dolomite found above is called "roof rock."

The thickness of this ground dolomite is generally not more than from 20 to 40 inches, and it is found in one, two, or even four layers, rarely more.

The ground rock is generally distinguished from the roof rock by its deeper colour, by the number of its cavities and its large grained bed ; often, too, by its feeble cohesion and its numerous crevices. The rock immediately covering the ore is generally, too, of the same nature as the ground dolomite, especially when there is any galena in it.

The ores are divided into two—compact ore and soft ore. This last consists of ochre of iron, the thickness of which is generally from 10 to 30 inches. In some places, however, it is as much as one lachter. This ochre, which is very easily crumbled, contains galena under every form ; sometimes it presents a woolly and red appearance ; sometimes we find it in little slabs with a rough surface, looking as if it had been melted, or in compact crystallizations, in very little, thin shells, in smooth crystals, in round grains, in flat morsels like coins, and, finally, in the finest slick.

The beds of ore, whether soft or compact, follow the same direction, and together form one or the same vein. Often these beds are united ; in the middle of compact ores we meet soft ores, and *vice versâ*.

In any large spread of the vein we may admit as a rule that the soft ore-beds are not covered, or, all events, very slightly covered, by the dolomite. It follows that the soft ore-beds occupy by preference the higher fields, while the compact beds are found rather towards the bottom, where the dolomite increases in thickness.

As the layers of ore are very little distant from the surface of the blue rock soil, their respective position is almost the same as that of this latter, consequently there is a dip towards the west and a backing off towards the west and north-west.

The deposits of the ore differ much as to their importance and their spread. The galena is often found in little separate beds, but may, however, form veins sufficiently extensive to cross the whole four divisions.

The principal veins are interrupted by barren intervals, where the vein ceases completely. Certain fields contain only small deposits, which have no communication other than the slightest trace of ore.

The quantities differ extremely ; thus, in certain parts of the mining field, as, for example, at the Kolpin Pit, the square lachter yields more than 100 hundredweight of ore and slick.

The highest yield that has been obtained in the richest beds of compact ore is a maximum of from fifty to sixty hundredweight per square lachter.

Among the deposits of ore which might still be extracted, they will meet with very few the yield of which would overpass twenty to twenty-five hundredweight. Up to the present date, the square lachter has produced, on an average :—

8·7 cwt. of sifted and washed ore.
3·5 „ of slick and wet ore.

Total, 12·2 „ of ore to be melted.

Each of the four divisions formerly possessed ore-washing sheds. In the "Pit Division" there were, besides the washing sheds for the clayey ores, six crushing machines with sweep-tables, besides a wet separating system without the sweep-tables.

These arrangements were established so as to profit from the fall of waters through a length of 600 lachters, but they involved a heavy expenditure in the transport of these weighty substances. At that period it was necessary to raise the water required for washing from two wells.

This labour demanded at least a third of the power of the large steam engine (30 in.), and the cost of this method was as high as from 5,000 to 6,000 thalers per year, in spite of all the saving in carriage and coal.

On the other hand the united force of seven water-wheels was no higher than three-horse power, and this for only eight hours a day.

The same circumstances were found in the other divisions, sometimes a special engine was worked to supply the washing sheds with water. At that period they never dreamt of remedying these inconveniences, because the pits were so scattered that it would have been difficult to bring together to any single point the whole of the ore found ; for the more careful washing which would have been thus attained would have been more than counterbalanced by the increase in cost and carriage.

But once when the whole mining industries of the Pit District had been purchased, and the principal works united, the moment had come to concentrate the washing sheds in the same place.

Machinery worked by steam-engines has been erected, and every possible arrangement made to facilitate the washing. An engine of 8 horse-power raises the water, partly from the mine and partly from a pond, to store it in a reservoir placed above, and this produces a fall of water on two wheels, 16 ft. and 11 ft. in diameter, the united force of which is equal to 4 horse-power.

[1] Carnall, "Journal des Mines." [2] *Ibid.*

One of these wheels in the large washing-shed, sets in motion the separating drum, the sweep-tables, the ore-crushing mill, as well as the sieves; the smaller wheel (1 horse-power) is used for the sweep-tables in the second washing shed.

All the ore which is treated at Friederichs-Hutte is examined, and its richness estimated before the reducing operations.

The estimation of the value of the lead ores coming directly from the Frederick mine, as well as the estimation of the ore extracted in the reserved lands of the state in the iron and calamine mines, is accomplished when the ore first comes into the factory.

In the same way they test the value of all the lead ores that are brought for sale to the establishment, which is authorized to undertake this kind of transaction.

Each ore, according to its quality and the place where it is found, is set aside, the weight of it is verified, and the degree of humidity stated.

To obtain an average of the yield, they take a portion of the ore and reduce it to powder under a rolling-mill. With this powder they make three packets of half-a-pound each. The first is used for testing; the second sealed, and bearing the name of the mine, the weight of the total lot, the quality of the ore, and the date of delivery, is kept for the direction of the Frederick mine; the third packet, also sealed and ticketed, is reserved for any experiments that the Control Department may wish to be tried.

The experiments as to the yield in lead take place in forged iron crucibles. The rich lead ores of High Silesia being exempt from any sulphurous metal, may be tested in these forged iron crucibles, which show the yield in lead much more exactly than any of the other systems. The tests made by the humid way do not present any sensible differences. The amount of silver is obtained by cupellation.

Each experiment is inscribed in a special book with notes as to the means employed.

The following process is used for these tests. The test powder is dried and properly ground. Fifty grammes are mixed with about 5 per cent. of black flux newly prepared. This flux is obtained by detonating one part of saltpetre with three parts of red tartar.

For poor ores, such as the slick, a little borax is added, 5 per cent. at most.

The crucible is filled in the following manner. They first place a layer of black flux, above that a mixture of ore and flux, then a layer of flux, and, as a covering, a little quantity of borax.

In this way the crucible is two-thirds full, so that sufficient space is left for the swelling and rising during the action of the fire.

Each test of lead requires from 20 to 25 grammes of black flux, and from 3 to 10 grammes of borax.

On an average one crucible may be used for thirty experiments.

Two crucibles exactly uniform in composition are closed up and put into an ardent fire for 17 or 20 minutes. At the end of that time they are withdrawn. The scoriæ, very fusible at first, and then the lead skim, are turned out upon the testing plate.

The lead skim, properly dried, is given such a form with the mallet as may make it suitable for cupellation. The weight of it is ascertained. The cupellation of the lead skim takes place in the ordinary manner, and the weight of the silver, too, is inscribed in the test-book.

H. C.

(To be continued.)

NOTES ON THE RESISTANCE OF BRICKS TO A CRUSHING FORCE.[1]

By George S. Greene, Jun., C. E.

THE bricks were of the kind used in the construction of the south gate-house of the new reservoir in the city of New York, by Fairchild, Walker and Co., contractors.

The experiments were made by Gen. George S. Greene, at Cornell and Co.'s, Centre Street, September 20th, 1860, in Hatfield's hydraulic press for testing building materials, built by R. Hoe and Co.

The bricks were what are known as hard brick, and manufactured at the yard of Wm. Call, Haverstraw, on the Hudson River; they are regarded as average samples of the mass of brick used in the construction of the gate-house. The experiments were not made in the interest of any person, but solely to determine the actual strength of the brick. In order to bring them within the power of the machine, but little more than half of a brick was used. The pieces of brick were first dressed by a stone-cutter, and then ground down on a grindstone. The faces exposed to pressure were not perfect planes, and therefore a layer of wood and sand was interposed between the faces of the machine and those of the bricks.

Dimensions of the Brick used in Experiments, in Inches and Decimals.

	Thick.	Wide.	Broad.		
No. 1.—	2·30	× 3·52	× 4·40	15·488	sq. in. exposed to pressure.
No. 2.—	2·24	× 3·50	× 4·46	15·610	„ „
No. 3.—	2·34	× 3·50	× 4·52	15·820	„ „
No. 4.—	2·34	× 3·46	× 4·46	15·4316	„ „
No. 5.—	2·30	× 3·46	× 4·50	15·570	„ „
No. 6.—	2·28	× 3·46	× 4·60	15·916	„ „

No. 1.—At 30,000 lbs. (= 1·937 lb. per sq. in.) cracked in centre; kept at 50,000 (= 3,228·3 lbs. per sq. in.) without crushing. Brick between two pieces of board half an inch thick.

No. 2.—Had a layer of sand. Sign of crack at 50,000 lbs. (= 3,203 lbs. per sq. in.) kept at 52,500 (= 3,362·2 per sq. in.) for three minutes, but did not crush. Crack did not extend through brick, nor was it broken into two parts.

No. 3.—Crushed to pieces at 43,500 lbs. (= 2,749·7 lbs. per sq. in.); packed with sand.

No. 4.—Packed with two pieces of cigar-box wood; edges crushed off at 30,000 lbs. (= 1,994·1 lbs. per sq. in.)

No. 5.—Packed with sand; cracked at 27,000 lbs. (= 1,734·1 lbs. per sq. in.); crushed at 32,000 lbs. (= 2,055·3 lbs. per sq. in.) Brick crushed and cracked in all directions; did not fall to pieces as did No. 3.

No. 6.—Packed in sand; commenced to crack at 30,000 lbs. (= 1,884·9 lbs. per sq. in.); crushed to pieces at 46,500 lbs. (= 2,921·6 lbs. per sq. in.)

[1] From "American Society of Civil Engineers."

IMPROVED COOKING VESSELS.

No. 1.

THIS is a new and ingenious American patented device, which may be easily arranged in connection with any ordinary pot, serving to retain the lid while draining the water from the contents. It consists in attaching to the cover two lugs or ears, A, by which the bail is supported in a convenient position for grasping, and which, when the vessel is being

emptied of its liquid, are pressed upon by the bail, thus holding the lid in place. On the side of the pot is made a projection, to which a handle is applied, and the utensils thus readily tilted.

[1] From the "Scientific American."

No. 2.

Messrs. L. P. and J. S. Bodkin, of Brooklyn, N. Y., have recently patented an improved cooking vessel, herewith illustrated, which is so constructed that its liquid contents may be readily poured off while the solid material is retained.

The device consists of a lip, formed upon one side of a boiler, to guide the fluid into a receiving vessel, and also of a grate formed upon the inner side of the edge of the forward part of the receptacle, the bars of which are connected with each other at their inner ends. These bars are made in triangular form; and, while offering the least possible obstruction to the escaping liquid, serve to hold the cooked substance within the pot. A handle is provided on the rear side for convenience in tipping. In other respects, the vessel is of the ordinary description in common use.

MILITARY EXPLOSIVES.[1]

THE almost exclusive monopoly which gunpowder held as a military explosive has of late years ceased, and, so far as mining operations are concerned, our old friend has been completely jostled out of place by the more powerful products of modern science. Gun-cotton, dynamite, lithofracteur, and other analogous compounds have largely superseded gunpowder as mining agents, both in civil and military operations.

Lithofracteur appears to have been occasionally used by the German Military Engineers during the war of 1870, and its employment during the siege of Paris was specially referred to by the military correspondent of "The Times." The composition of these several substances is now so universally known that it is perhaps unnecessary to give it; still, it is convenient for our purpose to refer briefly to it.

Gun-cotton is produced by steeping cotton fibre in a mixture of nitric acid and oil of vitriol. The cotton does not sustain any change in appearance by this treatment, but it increases considerably in weight. The cotton, in fact, parts with a quantity of water, and absorbs in its stead the elements of the nitric acid, which are much heavier than the water displaced. In this way the cotton is impregnated with a large amount of oxygen, which is thus ready, on the application of heat, to form gaseous compounds with the carbon of the cotton.

When this explosive substance is made according to the Abel process it possesses three characteristics which render it peculiarly adapted to military engineering operations. It can be stored and transported in the wet condition—that is, saturated with moisture—in which state it is absolutely uninflammable. While in this wet state it will explode with terrific violence if a small portion of dry gun-cotton be detonated in contact with it. Lastly, it may freely be brought under fire without fear of accidental explosion. The government works at Waltham Abbey are now in full operation, and under the active superintendence of Colonel Younghusband, R.A., large stores of gun-cotton, for torpedo and other purposes, are in course of formation in different parts of the kingdom. A small quantity has also been sent to Ashantee for use in connexion with military engineering services.

[1] From "The Times."

Nitro-glycerine is an explosive oil in many respects analogous to gun-cotton. It is produced by the action of nitric acid, mixed with oil of vitriol, upon glycerine, the sweet substance obtained when oils and fats are steamed. It is one of the most treacherous explosive substances known to chemists, and frightful accidents have been caused by incautiously using it in its crude state. In the course of many endeavours to counteract or reduce the sources of danger attending the use of nitro-glycerine, M. Nobel made the important observation that its explosive properties were not reduced, but, on the contrary, somewhat favoured, by mixing the liquid with solid substances, in themselves thoroughly inert. This led to the production of dynamite, which constitutes one of the safest, most powerful, and most convenient explosive agents applicable to industrial purposes, although it is not, in our opinion, equally applicable to military purposes. Dynamite is made by mixing nitro-glycerine with a porous, infusorial earth, known in German as "Kieselgühr." The earth absorbs the oil, and the result is a plastic, putty-like substance of a brickdust colour, containing about 75 per cent. of nitro-glycerine and 25 of absorbent earth. Dynamite is manufactured in this country by the British Dynamite Company, who have erected extensive works at Ardeer, near Glasgow. They make two descriptions—No. 1, or the ordinary "Kieselgühr" article, which contains about 75 per cent. of nitro-glycerine, and a cheaper quality called No. 2, which contains about 20 per cent. of nitro-glycerine mixed with nitrate of potash and powdered charcoal.

Lithofracteur is, practically, dynamite under another name. It generally consists of nitro-glycerine, sandy earth, powdered coal, sulphur, sawdust, and nitrate of soda or nitrate of baryta.

We have already stated that one of the characteristics of gun-cotton which contributes to its applicability to military purposes is that it may be freely brought under fire without fear of accidental explosion—that is to say, a package of compressed gun-cotton would not explode if struck by a rifle-bullet. If the gun-cotton were dry, the heat caused by the impact of the bullet would set it on fire, and it would then merely burn away with more or less fierceness, according to the amount of gun-cotton in the package. But if the gun-cotton were damp, the impact of the bullet would have no more effect than it would have on wood, earth, or any like inert substance. In the case of nitro-glycerine compounds, however, exposure to musketry fire would be attended by far more serious results. Under these circumstances, and at all ordinary infantry ranges, a package of dynamite or lithofracteur will explode with considerable violence.

Some interesting experiments on this point have lately been concluded in Austria, on the practice ground of Semering. The objects were to ascertain at what distance the impact of a rifle-bullet would fail to explode dynamite, and to decide what precautions were necessary in the transport of this substance in the field. The rifle used was the Werndl, which fires a bullet of 313 grains with a charge of 62 grains of powder. The experiments included a trial of dynamite, both in its plastic and frozen state, in comparison with gunpowder. About 24 ounces of dynamite were placed in a tin case, which in its turn was put into the centre compartment of a species of wooden limber-box, the sides or partitions of which were protected with sheet-iron of from 1-8th to 3-16ths of an inch in thickness. At the same time, a tin case containing about 10lb. of gunpowder was placed in a similar box protected with 1-20 inch iron. In the first trial the rifle was fired with its full service charge at a distance of 60 paces. The muzzle velocity of the bullet was 1,345 ft., which corresponds to that attained with our Martini-Henri rifle.

The results were as follows:—

The bullets perforated the boxes protected with 1-20 inch and 1-8 inch iron, and passed through their contents. Neither the gunpowder nor the frozen dynamite was affected, but the plastic dynamite was invariably exploded. The bullets failed to perforate the box protected by the 3-16 inch iron, and when the case which held the dynamite was not in contact with the iron partition complete protection was afforded; when, however, the tin case which contained the dynamite touched the iron against which the bullet impinged, the mere indent or shock of the bullet caused the dynamite to explode.

The results showed that the dynamite could be completely protected provided the cases which contained it were plated with about ¼ inch sheet iron. As, however, the weight of the transport waggon or cart, under these conditions, would be excessive, it was determined to continue the experiments with the view of ascertaining the destructive effect which might be expected from the accidental explosion of the ordinary field cart in which it was proposed to transport dynamite, and the distance at which a rifle-

bullet would determine this explosion. The cart was packed, as for service, with detonating caps, hand grenades, about 90lb. of dynamite, and 70lb. of powder. As a measure of precaution, the explosion was effected from a distance by electricity. The cart was blown to fragments, and the *débris* covered a circular area of about 100 paces diameter, some of the pieces being hurled to 300 paces. It appeared, therefore, that this latter interval should extend, in a column on the march, between the rear company and the first waggon. To ascertain the distance at which a rifle-bullet would explode dynamite, cases containing this substance were fired at with a Werndl rifle at 150 paces, but the charges were reduced to represent the velocity of the bullet fired with the full charge at distances of 3,000, 2,500, 1,500, and 1,000 paces. The dynamite was exposed to this fire (1) in its ordinary tin case, without other protection, and (2) enclosed as before in a wooden box (unarmoured). The results demonstrated that when the dynamite was simply shut up in tin cases the limit of explosion was between 2,000 and 2,500 paces. If the tin cases were placed in wooden boxes, the limits were between 1,000 and 1,500 paces. In our opinion the Austrian engineers appear to treat this matter much too lightly :—

"On pourra donc exposer, sans danger, la dynamite au feu de l'infanterie quand les distances seront supérieures, dans le premier cas, à 2,500 pas, et dans le deuxième, à 1,500 pas."

Such is the conclusion they have arrived at, while at the same time they look forward to the employment of this explosive agent in great quantities in future wars.

So far from this being the case, we think it highly probable that, unless some means be taken to protect dynamite from infantry fire, the use of this material in the field must be altogether abandoned. Under ordinary conditions of transport, it appears that a waggon-load of dynamite might be blown up and a frightful explosion be caused by the fire of a single skirmisher three-quarters of a mile away. Again, it must be remembered that these powerful explosive agents are especially useful as compared with gunpowder in hasty demolition. They are peculiarly suited for blowing down stockades, smashing in gates, blowing up bridges, &c., all which operations must be effected under infantry fire. Under any circumstances these duties have a forlorn-hope character, but if, in addition to other dangers, the unfortunate person who carries the "petard" incurs the certainty of being blown to atoms if the latter be struck by a bullet, volunteering for such service will simply mean certain death. Sitting on a barrel of gunpowder under fire would be far less dangerous.

Our service is, of course, free from this danger, because the agent we use, gun-cotton, is not liable to explosion when struck by a bullet; and, unless steel-plating or some such protective means be resorted to, we have little doubt that other nations will, before long, follow our example, and adopt a material which in lightness, in the security with which it may be handled or transported, the rapidity with which it may be applied, and the destructive effect it is capable of producing, is admirably adapted for the purposes of the military engineer.

ARTIZANS' REPORTS UPON THE VIENNA EXHIBITION.[1]

THE geographical position of our country, which certainly rendered England the commercial centre and emporium of the whole world, was not very many years since attended with serious drawbacks. Shut up within the four seas, and filled, perhaps, with insular pride, we were too often inclined to look with distrust upon the outer world, and upon all progress and improvement that was not directly of our own creation. "Every Englishman," says Novalis, "is like his country—an island." But the facilities for intercommunication of persons, of thoughts, of ideas—the "steam-ships and the railroad," telegraphs, cheap postage and a universal press are rapidly changing us all—even we English—into cosmopolitans. We have found out already that the old school-boy game of French and English, when both, with might and main, pull different ways, is profitable to neither, and now we are beginning to pull together, beginning to confess that here and there we have not only formidable competitors, but nations who in some respects are our superiors, and, by comparison, can in all respects teach us much. The frugality and artistic instinct of the Frenchman, the knowledge and patience of the German, the go-a-head and versatile powers of the American—we began by admiring these things—the next step is to imitate. These thoughts apply to all the arts and sciences—they apply still more fully to industry in its every branch.

Yet it was we who, thinking, scheming, deducting, first showed and taught the world the enormous value and potency of steam-driven machinery, and, labouring, plodding and improving, it is we still who supply power—the fruit of our knowledge—to all the nations on the earth. Our great men are, and always have been, of the greatest; but the average of our artizan class, our labouring class, will not bear an altogether favourable comparison with those of certain nations. They are in their workmanship industrious, thorough, plodding and true; but they lack the special gift of workmanship that comes from a special and technical—nay, even from a general education.

Much has been recently written, hastily and in some alarm, upon the superiority of the German nation in commercial life, and the discussion seems to prove that the Germans are in this branch, as in most others, as superior to the Scotch as the Scotch are to the English; and that the Scotchmen beat us because they have for generations had a good general education, and that the Germans surpass the Scotchmen because in addition to general education they have a special training for their work.

To ameliorate these conditions, the "Society for the Promotion of Scientific Industry" has been recently founded by the leading industrial men of the day. According to its motto, "The object of the society is the increase of the technical knowledge and skill of those engaged in the various industries; the improvement and advancement of manufactures and the industrial arts and sciences, and the general progress, extension, and well-being of industry and trade."

We cannot better show in full what the society endeavours and hopes to achieve than by quoting the inaugural speech of the society's president, Lord Derby, delivered at Manchester on the 16th January last :—

"Before I endeavour to explain to you what this society is, let me say briefly what it is not. It has nothing in it of a political character; nor do we intend to deal with that class of questions which of all seem to be occupying the largest share of attention at the present moment. Labour and capital will never be in want of a battlefield on which to fight out their traditional quarrel; they have all the world outside on which to carry on their war; but we don't mean, if we can help it, that it shall be carried on in our rooms. Our object is a purely national one—to do our part towards increasing and further developing the industrial resources of this country. That is an intention which no one can reasonably quarrel with. Increase of national wealth means greater comfort for the poor, better means of education, diminished pauperism, a lengthened average of human life, and, notwithstanding some temporary appearances to the contrary, I firmly believe that in the long run it implies habits of increased temperance and sobriety. It means, above all, a greater command of leisure. Hard and continued labour for subsistence is a necessary training in the early stages of society, when natural indolence is too strong to be overcome by desire for superfluities, but when men become sufficiently cultivated to desire and to value labour for rational purposes, the obtaining of it is one of the most reasonable objects towards which labour and labour-saving agencies can be directed. But I need not stop to argue a point as to which there is not likely here to be any difference of opinion. We have had experience enough to show us that a nation may be very wealthy and very patriotic, and, on the other hand, that collective poverty does not exclude individual demoralization. I only wish to put in a word of caution, lest we should be supposed to be aiming at a result not important or not desirable in itself. England is called a rich country, and so it is as far as capital is concerned; but if we take the average of individual incomes through the whole community, following the best statistics that can be had on the subject, and not forgetting that a large element of conjecture enters into all of them, we shall be surprised to find how low the average ranges. Thirty pounds a year for each individual, or £150 for every family, is the highest estimate that I have ever heard, and probably that is a good deal above the truth. Man for man, I think it may be doubtful whether we are not nearly equalled by the French in that respect; they have advantages over us both in point of area and of climate, and I well remember hearing one of the most experienced and wealthiest of European capitalists contend, not many years ago, that France was, on the whole, the wealthiest country in Europe. Late events have gone far to show that at least he had some grounds for his belief; and I am afraid that we can hardly doubt that the United States equal or exceed us, as they certainly ought, considering their boundless possibilities both in the way of agricultural and of mineral produce.

"There is one point which it is always necessary for us Englishmen to bear in mind when considering this class of ques-

[1] Published by the "Society for the Promotion of Scientific Industry."

tions—that to a greater extent our prosperity depends on causes which may or may not continue to operate. It is like the profits of a profession or a business, not the rental of an estate. In all civilized ages the liability of commercial and industrial supremacy to pass from one country to another has grown into a commonplace. You do not want to be reminded of the story of Venice, or of Florence, or of Holland, not to go back to remoter instances; and though nothing indicates that our industrial supremacy is seriously threatened as yet, and though for generations perhaps it may go on increasing rather than diminishing, still we have no right to expect that the laws which have hitherto seemed to regulate the course of human society will be suspended in our favour. If we look to the sources of our great industrial position we shall find that some of them are of an essentially temporary character. England gave greater security to person and property than any other European country in times when both kinds of security were very much rarer than they are now. England had extensive settlements in various parts of the earth at a time when settlements traded only with the mother country; and she had the command of the sea for many years, when it was closed by war against Continental Powers. She thus got a start in foreign and colonial trade, which she has not lost. Add to that, that in the use of steam-power, of machinery on a large scale, and more lately of railroads, we have had precedence in point of time over all rivals; and you will see that, both as regards manufactures and trade, we have been favoured during the last 150 years by a combination of circumstances such as we cannot reasonably expect to recur.

"No foreign state is likely again to drive out its citizens either by excessive oppression in civil matters, or by religious persecution; and if it did, any emigration so caused would more probably be directed to the New World than to England. No continental government is likely to be so desperately bad as to check in any great measure the natural tendency of civilized man to accumulate wealth. Foreign and colonial trade is open to all the world; we have no monopoly of mechanical appliances; and machinery, I believe, can now be produced nearly as cheaply and as well in Belgium as in England. In regard to all the matters of which I have spoken, the tendency is towards a level. We have not gone back, but others have advanced. I suppose it is in these parts a matter of pretty common experience that a man who succeeds to a business ready-made does not get up as early or work as hard as his father who had to make it. That will be our case if we don't take care. If we mean to keep our old position as the industrial leaders of the world we must throw away no chance, and leave no stone unturned. No doubt, in applied science, whatever discoveries are made or inventions brought into use by one country will soon extend to all. Still there is an obvious advantage in getting the lead; and that advantage we ought, if possible, to secure. Now what is our present industrial situation? What are the immediate or impending difficulties which we have to face? In the first place, the effect of our past and present success is that a demand for labour has been created greater than the country can easily supply. But scarcity of labour is increased by what may prove to be the growing tendency to emigrate among the working classes consequent on their increased knowledge of the world outside, and of the greater ease with which they can pass from one country to another. And it can only be checked by the very result which we most apprehend, viz. that when the demands of the workers have been pressed in any branch of industry beyond what the state of the market will justify, production here is stopped, and the orders are sent to foreign countries. Again, it is easier now than ever before for capitalists to send their money abroad, and, of course, if they can see their way to do that with safety and profit, they will. We have to consider the probability of a competition in which labour only will be supplied by the foreigner, the capital, and probably the directing skill also being English. That is a comparatively new state of things, but there are already thousands of Englishmen directing natives of other countries in industrial pursuits, and the process is not likely to stop. In old days a summary remedy would have been applied, but nobody now talks of keeping out foreign manufactures by a protective duty. That is an American and an Australian idea, but it is not likely to be ours. We are therefore in this position: if we can't produce cheaply we shall be undersold, even in our own markets; we have to compete with countries where wages are very far lower than here (who can say, looking forward, how those *officinæ gentium*, India, China, and Russia, may affect the labour supply of the future?), and we cannot expect that here wages will fall much, if at all, below their present rate. We are shut up therefore to one or two conclusions—either we must acknowledge ourselves beaten, or we must contrive to make every day's labour of a man more productive than it has been hitherto by the more general, or by the more skilful use of mechanical and chemical science. It is not power that is wanting. You have it, not in the steam-engine alone, but in every wind that blows, in every river that runs, in every rise and fall of the tide on our shores; and it may be in a hundred other forms not yet looked at or even thought of. You search underground for the material which is to produce heat, and it is heat itself that stops you at a certain depth. The question is not where to find your power, but how to apply it; the resources that nature offers us are illimitable; what is limited is our skill in turning them to account. If there is one lesson which history teaches us more clearly than another it is this—that national wealth depends in the long run comparatively little on natural advantages, and almost entirely on the qualities of the people who have to use them. But, further, it is not unassisted industry that will go far to create national wealth, though industry is the first and most indispensable element of production. Look at the Chinaman, who will work seven days in the week if you let him for pay which a European labourer could not live on. Look at a much higher type of being, the French agricultural peasant, laborious, frugal, temperate as he generally is, working his very life out for a bare subsistence on the little patch of ground which he cultivates, with nothing except his own labour and that of his family. Morally he is an admirable example; from an industrial point of view he is rather a melancholy spectacle, because, looking at these things as we do here, there can be no greater waste of power than that which is involved in a man doing with his own hands what he can command natural forces to do for him. Our own industrial history presents an exactly opposite sight. By joint action instead of isolated action, by economizing labour instead of squandering it, by following the rule of doing nothing for ourselves that we can get nature to do for us (imperfectly as we have followed it so far), we have accumulated in this island, with our population of not more than twenty-two millions, including women and children, and helpless persons of all sorts, power which is variously estimated, but which probably represents the labour of at least 500 millions of able-bodied men. There is no reason why we should stop there, and, in fact, we are not stopping. Many of you may have seen a remarkable letter, addressed by Mr. Caird, the agriculturist, to the 'Times,' in the beginning of the present month, in which it is stated that, notwithstanding an unusual scarcity of farm labour, the harvest of last year was got in without any unusual difficulty, the deficiency of hands having been made up by the increased use of machinery. That process will continue, and let me say, in passing, it seems very probable that the movement which is now going on to create an artificial labour famine in the rural districts by means of assisted emigration may lead to a result very different from what its promoters anticipate—grazing farms and machinery tending to make human labour redundant more rapidly than emigration will absorb it.

"However that may be, we see that every new mill, every iron work, every locomotive of the present day shows improvements on those which were made twenty years ago. If capital increases more rapidly than population, as it certainly has done of late years, and is probably doing now, so that the existing rate of wages is maintained or even increased, that process must in the nature of things continue. But if the modern system of doing everything by mechanism spares human muscles, it makes a larger demand than before on human brains. Taking charge of a locomotive is a more complicated business than driving a cart, and an Armstrong gun requires a good deal more looking after than an old 24-pounder of Nelson's time. Therefore, as the labourer developes into the skilled artizan, you require technical training, instead of the simple rule of thumb.

"Now, it is the belief of the promoters of this new society that a great deal may be done for technical training without interfering with that training of the workshop which is, in one sense, the best of all. They believe, moreover, that there are innumerable investigations of an experimental kind, having for their object the perfecting of industrial processes, which being everybody's business are nobody's business, which would in their results enormously benefit the trade or industry which they concern, but which individuals are slow to undertake, because they do not bring any certain return of profit to the person who spends time and labour upon them. If, for instance, we could hit upon a perfectly satisfactory plan for disposing of sewage—which certainly we have not as yet—the gain to the nation would be counted by millions yearly, but the inventor very probably might be a poorer man than when he began. What do you suppose is the value of the coal smoke that goes into the air in Lancashire alone? What is the value, the potential value, of those acids which you allow to pass out of your chimneys at St. Helens and elsewhere, and which are going a long way to make some districts in this county uninhabitable? Is it, or is it not, true that some manufacturers and some shipowners are getting fully

three times as much work out of every ton of coal as others, and if so, what is the amount of waste represented by the still continuing employment of imperfect and antiquated machinery? How much, again, remains to do in the way of utilizing waste substances? We do not wish to exaggerate our power or our prospects; but we believe that, by bringing together representatives of every industry that is followed in this district, and by providing all with the means of comparing notes and discussing matters which concern them, a great many ideas will be started, which would otherwise not come before the public at all; a great many plans which are more or less before the public will be tested and scrutinized; those that bear the test will obtain a more early and more extended publicity than they otherwise would have, and (which is also a gain) those that do not will be more speedily shunted out of the way. We propose to offer premiums and rewards for industrial improvements, whether in machinery, in processes, or in the use of new raw materials. We wish to hold exhibitions, not of a showy or merely popular kind, but such as may have a suggestive value; and the first of these exhibitions is about to be held. We hope to send out agents to report to us on industrial matters abroad; and, as a beginning in that way, I may point to an unpretending, but very well executed, little work, which we have already issued, being a series of reports from artizans sent out by us to the Vienna Exhibition of last year. We are ready to hold funds in trust for purposes connected with ours, if anybody likes to place them in our hands; and if our *status* becomes such as to justify our undertaking that extra duty. We believe, lastly, that the holding of examinations in technical knowledge, followed by the granting of prizes and certificates to those who have earnt them, may hereafter not unfitly come within the range of our duties. I think it is clear that scientific associations having a practical end in view are playing a considerable and perhaps an increasing part in our social organization, and I venture to add that if there is in England, or in the world, any place which is a natural and suitable centre for such a society, it is this city of Manchester."

The society had been in existence for about a twelvemonth before the delivery of this inaugural address, and their first work was one in which we feel a special interest. Month by month, from the date of our original prospectus, we have in the "Practical Magazine" preached the advantages of a careful study and comparison of the progressive industries of every country, and in our columns we have endeavoured to *focus* and *crystallize* every new thing, every unknown thing—no matter where originated—that was of moment to the world of Industrial Science.

On the 29th of April, 1873, the Council of the Society determined to send a number of selected artizans to visit and report upon the International Exhibition about to be held at Vienna. It was decided that every workman should be a *bonâ fide* workman, earning his living at his trade. The number of applicants was 320, and out of these nineteen were carefully selected, two of them being specially paid for by Manchester and Sheffield. The Birmingham Chamber of Commerce selected fifteen of their own artizans, and defrayed their whole expenses; so the total number of reporters who actually went was thirty-four.

The party left London on the 2nd of July, reaching Vienna on the 6th, and here they met with every possible attention and kindness from the officials, more especially from Baron Senborn, the Director of the Exhibition.

Among other instructions issued by the Council to the reporters were the following:—

"The object in sending out selected and skilled workmen to report upon the Exhibition at Vienna is, that the artizans themselves may be benefited by the lessons such international displays are calculated to teach, and that, through them, their respective trades may be stimulated to improvement.

"It is not intended in any way to fetter the reporters with any instructions as to their method of reporting, but each one will confine himself to his particular industry. Their best discretion must be used, and attention may be profitably directed to the following points:—

"I. A comparison of the quality and character of the work exhibited by the different countries.

"II. The new features in old manufactures, machines, and processes, and the principal points in new ones.

"III. Relative cost of materials, wages, conditions of labour, &c.

"IV. Special features of national exhibits."

"The *Reports*," says Mr. Larkins, the secretary, "are the work of English artizans, and as such must be read. In publishing them the Council venture to express their belief that they are no mean addition to industrial literature, and do no discredit to the intelligence and powers of observation of British workmen. Of the value of such reports there can be no doubt; in addition to the value of the influence of them upon the writers, there is that wider influence that they must have upon their fellow workmen, and upon the manufacturer."

The *Reports* have recently been issued by the Society, and the greatest care has been taken to preserve the characteristic features of each one. The volume consists of some five hundred pages, divided between the men sent over by the Society, and the men sent over by the Chamber of Commerce at Birmingham. The two editors, Mr. Larkins and Mr. Aitken, have done their difficult work admirably.

We now proceed to give the most important items of each Report, weaving them all into a sequential narrative, and preserving the language of the writers.

To put the reader thoroughly *en rapport* with the tone and feeling of the expedition, we first quote,—

Social and Working Habits and Customs of German Workmen.

Work, Wages, &c.

"The population of Vienna is set down at 1,000,000, the trades population at 100,000, and the total number of workmen in Austria at 6,340,000. Of these there are miners 104,256, and employed in salt mines 12,771. I quite believe that the workmen are so situated as to become first-class at their trades. Their educational advantages are certain to be a power to them; they seem to be in education where we are in workmanship; in fact we need their school learning, they our workshop knowledge. The hours of labour are twelve for adults generally; agricultural labourers and farm servants often work fifteen hours per day, but there is no uniformity. Children seem to work from six to ten hours daily; Saturday, perhaps, one hour less in most trades; Sunday, sometimes till noon. I have seen Austrian workmen do excellent work, which could not be surpassed. But I feel certain they cannot in the same time produce work equal in quantity and quality to that of our workmen. They seem to lack the dash and continuity of our workpeople, so that this extra time is equal to an advance in their wages—as it is the total wages paid, and not the weekly wages, or hours worked, that determines the price of an article produced.

"All Austrian workmen could read. Bohemians were good at hard, but not at intricate, work, excepting those who had come to Austria when young, and who could now do the best work with despatch. Men staying off work through drink was a rare occurrence indeed. The wages of some classes of men in the country were 10 per cent. less than in Vienna. But the countrymen had more comforts and were best off.

"All the workshops I visited were clean, comfortable, and fairly healthy; the men, too, seemed cleanly, clad in plain, serviceable clothing. Many of them worked with bare feet in the joinery works.

"Considering their economical manner of living, their inexpensive enjoyments, and the progress these men are rapidly making in most branches of industry, they are not rivals that we can afford to despise. They have a broad margin for improvement. We have small growing space beyond improving upon ourselves.

"Brunn, a manufacturing town, furnishes another sample of life. Here, as at Vienna, there are no beggars, or 'miserably poor;' the people are largely employed at the woollen mills, the girls earning about 5*s.* 6*d.* per week—*three* girls doing 10 per cent. more than *two* girls would do in England; but they work seventy-two hours per week, as do the men, who earn 10*s.* to 14*s.* per week. The English overlooker (as a teacher of Germans), who would earn about 30*s.* in England, receives at Brunn about £4; but very few of such men are retained. No work is done on Sunday except by the clerks and warehousemen, and 'odd jobbing.'

"The people here and at most other towns and places are crowded together to sleep, irrespective of age or sex, as many as can be got into one room. The number of persons in one room is limited to the space required for them to sleep in. Illegitimacy and concubinage is common to all classes. The wages are stated officially to be, throughout Austria—Engineers and mechanics, cabinet-makers and joiners, 26*s.* to 28*s.*; labourers, 10*s.*; plumbers, 16*s.*; silversmiths, 12*s.* to 14*s.* per week; and joiners, 5*s.*; tailors, 4*s.* to 6*s.*; smiths, 4*s.* to 6*s.*; builders' tradesmen, 2*s.* 8*d.*; labourers, 1*s.* 8*d.* per day; agricultural labourers, £5 per annum, with board, lodging, &c.; Vienna upholsterers, 20*s.* per week. Hours in most trades about sixty to sixty-five per week. These rates do not include board, lodgings, and other conveniences, except to the agricultural labourers, and which must always be regarded as so much wages. There are seventy-six whole holidays in the year.

Women's Work.

"Work usually done in England by bricklayers' labourers is

performed throughout Germany mainly by the women, whose dress is one remove from Mother Eve's before the fall, and though very economical and convenient, would be here regarded as indecent. These women mix the mortar, carry the bricks, lift the stones, and attend generally upon the men.

"Street cleansing is mostly done by women, but sometimes men work with them. I noticed women working as navvies in excavating foundations; they took the shovel or the barrow, as the case was; so it was with the women plate-laying on the railway. But I marvelled that, whilst nearly all the men had shoes, the women usually had none. Besides the work named, I witnessed several women working at mowing, ploughing, and general farmwork, drawing a cart with the aid of a dog, taking care of railway crossings, working as porters, carrying loads (in creels strapped to their back), and as gardeners.

"These labouring women are mostly Bohemians. The Bohemians, men and women, seem to do the hard work in Vienna.

"Much of the portering, such as we see done at home with donkey and cart, is commonly done with dog and cart, driven and drawn by women. The loads these dogs draw are surprising. There are often two dogs to the cart, or a woman takes the place of the second dog at one side of the shaft, and runs along with the cart. I observed less of this means of conveyance in Vienna than in Dresden and Aix-la-Chapelle. Churches are seemingly open at all times of the day, where the very poor and women were the most noticeable at devotions.

"As we both arrived at and departed from Vienna on a Sunday, I was struck by the contrast to an English (and especially a Scotch or New England) Sunday. In fact, Vienna is as busy and as lively at six o'clock on a Sunday morning as Manchester would be on a week-day at eight or nine o'clock, even to the gentry driving out in carriages, and all the *et ceteras* of everyday life. There is some work done in the workshops on Sunday, but it is scarcely the rule, and when work is done on Sunday, it is only till noon, and is optional with the men.

Trade Unions.

"There seems to be little of the kind of trade associations known as 'Unions.' Those which have existed seem to have languished; hence we find no uniform rate of wages, hours, or trade customs. The existence of courts of arbitration, however, prove that there must be some matters of difference to settle.

"Strikes often terminate by the men carrying on business in their own trade by means of co-operation. This applies with greater force to North Germany, where the workpeople are better educated than in the South. There are travelling unions, which assist the members by way of a bed and breakfast in each town.

Cost of Living.

"Clothing of the same kind and quality is not much less than in England; but although the Germans usually dress well on Sundays and holiday times, they do not regularly wear expensive clothing.

"It is not often in Vienna—but quite common out of it—that the employers supply dinners for the workpeople; and it is officially stated that 46,739, or 13·7 per cent. of the entire working population are thus wholly or partially provided with board. Some employers furnish provisions at the market prices; others have cheap eating-houses or cafés on their estates; and patches of ground are allotted out to the workpeople. Some trades, as joiners, are furnished with tools, which are considered in the wages. Trade, like government, in Germany, is more paternal than independent.

"It is estimated that the cost of a single man's living for one year is—board, £36 10*s.*; lodgings, £10; clothing, £6 14*s.* Out of the large towns these expenses are less. Dr. Engle estimates that the cost of food absorbs 62 per cent. of an annual income of £45 to £60. In such cases lodgings cost about 12 per cent. But I regard these estimates as extremely liberal. It must be understood that the food is not such as would satisfy the British workman, whom I hope never to see content with the house accommodation of Vienna.

"The wines and beer commonly drunk in Germany contain very little alcohol, so people drink an immense quantity and do not become intoxicated. Drinking is mostly done at eating times; stronger drinks, as brandy, whiskey, and British beer, are seldom indulged in. Austrians will often sit in a café and drink only about two glasses of these weak drinks. With them it is more a matter of making a meal, or listening to music, than mere drinking.

"I think I saw not more than one person intoxicated, and he was an Englishman, and had been taking stronger drink than is usually taken by natives. Some half-dozen of our party compared notes on this head, and their experience was like my own.

"Feeding at the café and sleeping at the lodgments would be a poor substitute for our English home. One finds at the entrance to what are, externally, handsome mansions, the wives and children of the apparently poor. It is their domicile or lodging-house. All the rooms, landings, stairs, &c., are wonderfully clean, and this under unfavourable circumstances, as the rooms are let off to so many families. The common entrance to all is through a hall-way, the keeper of which requires a penny from every person admitted after ten at night until four next morning; at which hour almost everybody is on the move, especially the women, who will be found doing all kinds of domestic duty soon after that hour. I was told by an Englishman who took me to his lodgment (a very comfortable, clean, and respectable-looking apartment) that three hundred persons lived in 'that house,' which seemed a fair sample of 'lodgments' generally in Vienna. If you are asked to sup with a friend, or dine, or take tea with him, you meet him at a café for the purpose—home, or 'lodgment,' is never dreamt of. The workmen's apartments and surroundings are certainly not what would suit a British workman, neither are the internal fittings or the conveniences such as would please our tidy housewives, to say nothing of having to fetch the water from the public well, often a great distance from the house.

"In many districts the dwellings are built by the owners of factories or mines, just as is done in all new industrial countries (it is so in America). These dwellings are frequently purchased by the working men out of wages that would be regarded as extremely low in England, many Englishmen spending more on themselves than these men earn. About 60,000 are furnished with lodgings by their employers. In Vienna the large buildings, or lodgments, present the appearance of gentlemen's mansions, with hall entrances, and a gateway opening into a large square court-yard formed of four extremely large buildings, two or more of which may have their entrances from the said court-yard. In this way it will be seen that the land is more closely built upon than it could be on any other plan. Indeed, the consideration seems to be, firstly, how many lodgments can be built upon the least space; secondly, how many persons can be lodged in each room. Yet I daresay the people are very much astonished at the sudden appearance of cholera and other epidemics. I wonder that these places are not constantly afflicted with such diseases.

Education, Co-operation, &c.

"From the consular reports received by our Foreign Office we learn that there are 'many excellent trade schools' and 'drawing and Sunday-schools are provided by some mine proprietors.' The law (1809) makes attendance at school (from the ages of six to twelve years) compulsory, and even for a longer term, if needful. The religion taught is according to the parents' choice, or the creed in which the child is born. The religious teaching is during stated hours, from eight to nine o'clock in the morning, twice a week, and the child may be absent, at will, from such religious instructions. Before the above law was passed the cost of educating a child was 2*d.* to 3*d.* per week. The new law has done very much good, and though evaded sometimes, it is generally well observed; and the officers enforce the law strictly, and the people regard it with much favour. But education must have been highly appreciated before this law was passed, as a totally uneducated Austrian is rare.

"The Working Man's Education Union in Vienna is doing a most important work, and the association is duly appreciated, as proved by its membership, numbering 8,000, out of a trades population of 100,000.

"The progress of co-operation—and that, too, in the higher and more difficult branches, in which it has been found almost impossible until recently to make any progress in this country—proves the Germans to have both intelligence and education, and serves as an exhibit of their self-denial, prudence, and power of organization. The following will show the great progress of the co-operative banks in North and South Germany during eleven years:—In 1859 there were 80 societies with 18,676 members, who had money on loan = 4,131,436 thalers; share capital, 246,001 thalers; and in 1870 these figures had risen to 740 societies, 314,656 members, 207,618,287 thalers lent; and the share capital had risen to 13,449,152 thalers (a thaler is equal to 3*s.*). Even during the Franco-German war the number of co-operative banks increased by 121, and 112 new stores were opened, while 9 manufacturing societies were established. The business done by all these societies in 1870 amounted to 350,000,000 of thalers. The paid-up capital was 27,000,000, and the loan capital 62,000,000. The number of co-operators now in Germany exceeds 1,000,000. Amongst the 'Magazine Associations,' there are of shoemakers, 65; agriculturists, 43; tailors, 37; cabinet-makers, 24; smiths, 8; weavers, 5; bookbinders, 4; glove manufacturers, 2; carpenters, 2; basket-makers, 2; house-painters, 1; millers, 1; cloth-makers, 1; sewing ma-

chinists, 2; booking establishments, 1; house-building establishments, 5; and they appear to make most progress in co-operation just where we make least.

"Provident societies are a thriving institution in Austria; nearly every workman belongs to a friendly society. The weekly payment is about 10*d.*; the weekly allowance during sickness, 10*s.*; and funeral allowance, £2 10*s.* These benefits appear ridiculously small to us, who, for a weekly payment of 6*d.*, can secure 10*s.* per week (from temperance societies, 12*s.*), and £10 at death. But these societies are purely local, and must therefore be very expensive in their management, and with us would not be deemed safe. Perhaps this accounts for the smallness of the benefits.

"I never saw nor heard of a beggar while I was in Germany, whereas, in London, I should have seen hundreds.

"I was assured that in Vienna one-half of the children were born to parents out of wedlock; that it was common for a business man to have a much larger family than lived under his roof or in his rooms. In a large city like Vienna immorality is to be expected. But, when nearly the same may be said of a place like Brunn, there exists a state of things which would alarm us at home. I was informed by persons who were enabled to know, that living together without marriage was very common. The conditions or hindrances to marriage are such as would bring about like results at home.

"All able-bodied men are liable to serve in the army. A man cannot marry during this time, unless by the consent of the Secretary of War, or the general under whom he is serving.

"After all that is said of Vienna morals, I could not but notice the fewness of the lewd women in the streets, and their remarkably good behaviour.

"In conclusion, I would say, if, as I believe, one and a quarter hour's labour per day will earn for every man all that is needful for his health, and if the Germans go on with anything like their present frugality, our commercial supremacy may be in danger; for as one person in England can produce calico enough for 550 persons, we must look to other nations to purchase the bulk of it. And so with other goods, for we are the world's principal workshop. At present, it is clear that Germany has a much broader margin for improved production than we have. It has the elasticity represented by how far we are in advance of them. We can, in the main, only improve on ourselves, whilst they are armed by education, and aided by our example as to work. So far, we seem to be superlatively their superiors in sound, solid, utilitarian workmanship, and, I may add, in bad taste. On the other hand, we can learn of our German cousins some of their frugal and temperate habits, polite demeanour, and good taste. The exchange will be a mutual advantage."

Woodwork and Joinery.

Wood-converting Machinery.

"Worssam and Co., London, exhibit, among other things, an arrangement for giving the 'drunken' motion required in a circular saw when used for grooving purposes, by means of one washer and a set screw, thus dispensing with the sets of bevelled washers commonly used; also a set of machinery for preparing parquetry flooring, including a disc for turning up the squares when glued together, and a table with vertical spindle, enabling two men to work at one pair of cutters; the timber is held firm on the table by an eccentric roller.

"Messrs. Allen, Ransome, and Co., London, among their machines, exhibit a hand mortising machine; and endless as is the variety of these machines, there have been improvements made in them of late. For instance, this firm lowers the table instead of the chisel, and if the screw and supports are only made strong enough, the advantage is great, inasmuch as it not only maintains the stroke at one uniform height, but the spindle carrying the chisel sliding in perfectly rigid bearings is an additional advantage.

"The pneumatic apparatus of Messrs. Allen, Ransome, and Co. ought not to be forgotten. By means of this arrangement all dust and shavings are carried away, thereby promoting health and economy, and lessening the risk of fire.

"The English makers seem generally to strive to obtain such a form of machine as will enable them to cast the frame in a single piece, and to secure solidity, accurate fitting, and—ugliness. The utilitarian character of the people is shown in their machines. The exhibits are precisely the same articles which will be sent from their workshops in the ordinary way of trade. The same everlasting lead colour, the same stiffness of outline, and also the same accuracy and strength.

"The general design and decoration of the American machines is superior to the English, though, for practical utility, they are no better, and in point of strength and solidity they are scarcely so good.

"There are some very compact moulding machines by Rogers and Co., Norwich, Connecticut, some of the small ones at a very reasonable price.

"A new machine to supersede dovetailing, by Knapp, of Northampton, Massachusetts, executes some very good though novel work; and its small size, and neat appearance, will commend it to the public.

"J. A. Fay and Co., Cincinnati, show a tenoning machine with narrow frame, enabling the attendant to feed quite through the cutters without leaning over the table. Those who have worked a tenoning machine will appreciate this arrangement. There is also a beautiful machine for making buckets.

"In the French section, F. Arbey, of Paris, exhibits a considerable number of machines, including a trying machine with spiral cutters, the sharpening of the cutters being accomplished by means of an emery disc travelling over them when in motion. I have been unable to see any advantage in this arrangement; for when we consider that the primary object of such a machine should be accurate work, and not simply clean work, and when we also bear in mind that a cutter for a 24 in. machine must be 28 in. to 30 in. long, the difficulty of securing an even temper over such a length of steel, and the impossibility of applying a straight-edge to a spiral surface, makes me think that spiral cutters will never be very extensively used for trying up machines. Several other machines are shown by this maker, including several saw benches for manual power, very cheap, and some of them apparently well adapted for light work.

"There are machines of various kinds from various countries, scattered up and down, but none of them, so far as I saw, calling for special remark."

Joiners' Tools.

"Heissinger, of Nürnberg, shows a case of joiners' tools in boxwood, and a cabinet-maker's bench. The case is a credit to him, both in design and execution. The tools, also, are well finished, but peculiar in shape; the handle at the front end of the planes would be puzzling to an English joiner. There are no hand saws, and the square blades are very narrow, which must make it easy to force them out of square.

"Next is a case of tools from Leipsic. Here we see the marked difference between the English and the German tools. The bench planes are very narrow, the moulding planes are all worked upright instead of being sprung, as ours are, the clumsy looking frame saw, and the variety of tools for doing the work which the English joiner would do with his plough alone, did not tend to impress me with a belief in the superiority of the German tools. The exhibitors of this case have had a medal from some exhibition, but most of the tools I saw an English workman would consider rude and obsolete. There are other cases of tools from Rhenish Prussia, many of them well finished, but the hand saws are conspicuous by their absence.

"Of the English makers, Spear and Jackson, Ward and Payne, Kenyon and Co., and others, show joiners' tools, principally steel tools. The grinding of these tools is superior to anything of Continental manufacture. I could have wished that the show of planes and other wood tools had been larger."

House Joinery.

"In Venetian blinds, circular headed windows have generally been a difficulty. In one case this is obviated, by an arrangement like two fans, which close up the arch, and have a very neat appearance. In England, when the blind is drawn up, part of the light is blocked out, and the window practically shortened. In Vienna they often obviate this, by forming a box above the sash head, and drawing the blind into it, a great improvement upon our plan.

"In parquetry flooring, England is a long way behind. Perhaps it is that our damp, cold climate causes us to prefer carpets; but, be the cause what it may, although there are many specimens of this class of work, I saw none but what were from Continental countries, some of them very elaborate and beautiful in design, and superior in execution: in fact, there was no class of exhibits which struck me as being so uniformly good. I am informed that most of the machinery which is made in England for this work is sent to the Continent. Some of the principal exhibitors are Carl Sterkel, of Ravensburg; Bauer and Rehorsh, Breslau and Berlin; Blumer, Strasburg; and Tasson, of Brussels. The Brussels flooring was specially excellent, and in these exhibits Belgium partly retrieves her character.

"As in most Continental exhibits, the judicious choice of colour strikes the eye of the English visitor, as something to which he is not accustomed."

Cabinet Work.

"Nothing struck me more in examining the German specimens of cabinet work than the wide difference in the quality of

the workmanship. The designs were generally excellent; but taking two pianos placed almost side by side, in one, the joints were painfully apparent, while in the other, by F. Neumann, of Hamburg, the framing and cross-banding were perfect specimens of clean workmanship.

"Among English exhibitors, Messrs. Jackson and Graham, Holland and Sons, Walker and Sons, and others show specimens of the skill of the English workman. The two cabinets by the first-named firm, executed from designs by Owen Jones, are perfect marvels of workmanship, both inside and out. The one in ebony and ivory is a masterpiece of cabinet work; the most rigid scrutiny on my part failed to expose a single flaw. The second firm show a splendid marquetry table, and the others have articles which fully maintain the honour of England.

"The Italians show, from Milan and Florence, a quantity of furniture. From the former city comes a suite in mahogany and oak, beautiful in design, but wretched in execution; also an ebony and ivory cabinet, with lapis lazuli and jasper ornaments, very badly made; and if it could be placed beside that of Jackson and Graham, the contrast would be plain to the most superficial observer. There is also a marquetry cabinet from Carlsbad, full of work, but of a very inferior quality.

"There are some very fine specimens of timber shown in the Exhibition grounds, among which is a piece of straight ash, 93 ft. long, 2 ft. 8 in. at bottom, 1 ft. 4 in. at top; a beech, 80 ft. long, 3 ft. at bottom, 2 ft. 4 in. at top; and a splendid pine about 150 ft. long, 3 ft. at bottom, 11 in. at top. The timber most used in Vienna is oak and a species of spruce fir of two kinds—one resembling American spruce, and the other not unlike Norwegian red deal—neither of them very easy to work, and that makes me wonder that machinery is not more generally used. Much of the timber used in Vienna is rafted up the Danube, and the price of oak at the quay, when purchased in considerable quantities, was given me by Herr Paulick at about one gulden sixty kreutzers per cubic foot, or something like three shillings sterling. The timber used in Dresden is rafted down the Elbe in the same manner.

"I visited the workshops of Herr Friedrich Paulick, and was received by that gentleman with the greatest kindness and cordiality. I saw there—what I am sorry to say I never saw in England—trees and flowers growing among the piles of timber, and looking in at the office and workshop windows, so that the workman could look out not at a brick wall but on a flower bed.

"The conclusions I have come to as the result of my visit are, that while our workmen, and, indeed, many of our architects, are very far behind in art knowledge, and have very much to learn as to design, especially where colour is made a predominating feature, we are as a nation greatly in advance in the quality of our workmanship. For, taking the exhibits in deal shown in the Exhibition, I do not hesitate to say that superior work can be found any day in the workshops of almost any building firm in England professing to do good work.

"Again, the great difference in the quality of the exhibits, to which I have already referred, seems to indicate that the best specimens are the work of isolated individuals, and are not to be taken as criterions of the average skill of the districts from which they come."

Mr. Smith scatters a few good suggestions throughout his report. He complains that too much importance has been attached to the geographical position of the country supplying the article exhibited. Had the whole of the articles been arranged according to material or class, the work of three days could easily have been accomplished in one, and comparisons could have been made with much greater ease and certainty. He suggests, too, that exhibitors should allow measuring and sketching within reasonable limits.

CUTLERY.

The Exhibits of Different Countries.

"Nearly every country displays some specimens of cutlery; nations cannot progress without cutting tools. Belgium, though manufacturing cheap pocket and table cutlery, is only poorly represented. Case 448 displays good swords, both in the blades and finish. Fonson and Sons need not be ashamed of their workmanship. The same remark will apply to A. Lambermont (Case 449), Brussels, and case 282, exhibited by Bazet Brothers, of Liége. Russia has a much better display of sword cutlery and daggers than of other departments of cutting implements. Robert Bohte is the exhibitor. He has obtained medals at Moscow, 1865; Warsaw, 1867; Paris, 1867; Petersburg, 1870; and Moscow, 1872. Schaff Brothers, St. Petersburg, show a fine sword, inlaid with gold and ornamented with precious stones. Rhenish Prussia is represented in swords and bowie-knives by Fred Esser and Co., Haarhaus, Elberfeld. There is nothing special in this branch of industry from England or America.

"In surgical instruments, Group XIV., several nations are represented. Peter Fischer, of Pesth, has a good display. The amputating knives look like English work. I. Mang, of Prague, shows a case of instruments, not equal to Fischer's. In the same court Dr. Schrotter and Henrich Reiner exhibit; some of their instruments are rather coarsely finished. The same remark will apply to Joseph Leiter, Vienna. Rudolf Thurrigl, Vienna, maker to the Austrian Government, displays good and varied instruments; and this remark will apply to J. Sobel, Gratz. In this department of cutlery none equal the celebrated successors of Charrière, No. 6, Rue de l'Ecole de Médecine, Paris."

Saws, Files, and Edge Tools.

"These articles have long been staple trades of Sheffield, and the town is represented by Messrs. Spear and Jackson, Ward and Payne, John Kenyon and Sons, and others. Taylor Brothers, Adelaide Works, exhibit a circular saw, 7 ft. 2 in. in diameter. It is described as best cast steel. The saw is perforated, hardened and tempered, and ground by patented machinery. The principle of the invention consists in the perforation of a number of holes under each tooth.

"The case of John Kenyon and Co. is near the last, and this old-established firm has an excellent assortment of saws, files, edge tools, and centre bits. Their circular saws vary from about one inch to five feet in diameter. Their tools are varied and well finished. In files, the selection, if not large, is varied and excellent. This firm has long had an extensive Russian trade, the result of honourable trading. Next to Kenyon's case is that of Ward and Payne's. They have a first-rate display of edge and joiner's tools. In carvers' tools they are remarkably strong. For neatness, variety, and finish, there is nothing equal to them in the Exhibition. This firm also displays a great variety of sheep shears, superior to anything of the kind shown by any other nation.

"John Weiss and Son (No. 417) show machine blades, chopping knives, planes, and edge tools. They have won thirty medals and five honorary distinctions. They show tool chests in great variety; a large and good collection. Antonio Benesch and Peter Brank exhibit various cutting implements; their drawing knives would be better if the handles had ferrules. H. Tyrolt, of Vienna, exhibits a few tools of a high character. Case 109, J. Braun and Sons, contains a large assortment of files, saws, machine knives, &c. The files are of all sizes, from one inch up to thirty-six inches. Some of the files had the end of the tang rounded, to do without hafts. This is not uncommon with German files. In the using, they cannot be held so firmly in the hand as a haft. The large half rounds were not well covered in cutting. An additional row of teeth would make them more serviceable. In rasps, single-cuts and large dead smooth files none of the continental makers equal the English.

"W. Kranziger (Neuterchenfeld) has a show of files, principally half round rasps, and several steel discs, cut all over. They are intended to be worked by steam or water power.

"H. Wuster and Co. (Cronenberg) exhibit saws—circulars, long, hand, and web—in great variety. Files, well assorted, chisels, and plane-irons, highly polished. Skates and sheep shears; the latter not equal to Ward and Payne's; still Wuster and Co. need not be ashamed of their display. Robert Landon (Cronenberg) has a good lot of saws marked with his name. Edward Engels (Remscheie), along with his other exhibits, shows an immense variety of skates, both plain and ornamental.

"Sweden and Norway, cases Nos. 431 to 437, contain saws, tools, skates, and swords. There is no special merit in any of them. In this department of industry, it is a matter of regret that America is not better represented. The Douglas Axe Company have a good show of axes, adzes, and manchet knives. In the same court there was a good display of agricultural and sappers' tools; and at one end of the court there was a small case of joiners' planes. I have seen American tools in Sheffield equal to any in the world; it is, therefore, matter of regret that the United States did not appear in greater force at Vienna.

"The saw and edge tool trades in Sheffield have not increased with the growth of the population. In 1833 a Parliamentary Committee sat, to inquire into 'Commerce, Manufactures and Shipping.' Mr. Samuel Jackson (Spear and Jackson) was examined as a witness. In his evidence he admitted the superiority of Sheffield in making large saws. In the making of small web saws the Germans and French have cut us out of the market. In larger work it will be seen we still maintain our superiority. The opposition of the Trades' Unions to machinery has doubtless sent a portion of the saw trade to America and other places. So far back as 1842, the effect of the restrictive policy of the saw trade was seen by all intelligent persons who took an interest in trade questions.

"In the interval between one exhibition and the other there has been a gradual introduction of machinery in the different branches of the saw trade, which has done much to supersede manual labour. All the saw grinders in the world could not grind saws like Taylor's and Spear and Jackson's circulars so well as the machine. In 1860 Wheatman and Smith, of Sheffield, put down a machine for grinding long saws. That was blown up, under the instigation of the secretary of the grinders' union, and at the present time the man who did the "job" is grinding long saws by machinery on the opposite side of the river to Wheatman's Works. A wiser policy would have kept the trade at home. Restrictions have fostered rivals in America, where machinery is common, who are our most formidable competitors. Still, without a high protective duty in the States, I feel confident that Sheffield can maintain its ground, even in America.

"The file trade is one of the largest and most important in Sheffield. In a paper read before the Social Science Association in Sheffield, 1865, by Dr. J. C. Hall, the numbers employed in the trade are as follows:—

Forgers and cutters	3,500
Grinders	250
Hardeners	200
Females	300
Boys	1,000
Dressers, strippers, &c.	300
Managers	200."

Watchmaking.

"I do not think there were one hundred English pocket watches exhibited in the whole Exhibition, and little if anything that was new among them. Second, in the French and Swiss departments, amongst the representatives of exhibitors, only a few could speak English, and I could only speak that language.

"In looking round the exhibits of watch manufacturers I found that there are few attempts at reducing the cost of making up watches. The English watches shown in the Vienna Exhibition are, as far as workmanship, &c., is concerned, as near perfection as possible; but the price asked for such watches demands that it should be so. When £35 is asked for a plain full plate lever watch, it is only to be expected that it is the best production of skilled workmen.

"What we want, in my opinion, and in the opinion of almost all the watchmakers I have come in contact with, is a watch capable of everyday wear, and keeping reasonably correct time, at a cost making it accessible to everybody. I know our watch manufacturers will say they do supply such a watch; but my experience is against that, for the middle priced English lever watch is no more to be depended upon than the same class of Swiss watches. A well finished and well cased silver lever cannot be sold at present under £8 to £10.

"I may here at once say that I saw nothing new (in our trade) of any importance, or likely to effect any radical change in watchmaking, in the Exhibition.

"M. Louis Andemars, of Brassus, Canton de Vaud, Switzerland, exhibits one of the finest collections of pocket watches in the Exhibition; mostly complicated, such as clock watches, minute repeaters, calendars, &c. Pre-eminent among his exhibits is a watch he describes in his catalogue,—'A clock watch, strikes hours and quarters in passing, minute repeater, independent seconds, one stopping for observations, marking simple and one-fifth of seconds on the same axis; two sets of hours on dial, full calendar and moon-phases, metallic thermometer, anchor escapement, compensated balance isochronal spiral, 45 rubies, treble keyless work, and double setting pin, 21 lines. System invented by Louis Andemars. The first watch, with all these complications, was manufactured by me in my workshops in the year 1867.'

"This is *par excellence* the most wonderful piece of mechanism in the Exhibition. Everything in and about it is finished to perfection. M. Andemars has certainly succeeded in cramming a greater amount of machinery into the smallest space that any man, either now or before him, ever succeeded in doing, and it does very great credit to both his genius and persevering industry. To give an idea of the complication of the watch, I would not undertake to merely clean it for a sum less than £5. The same maker also exhibits the smallest minute repeaters ever made, the movement being no larger than a shilling; his genius evidently lies in the direction of producing extraordinary complications. Among other firms who exhibited very high class watches were Patek, Philippe, and Co., H. Grande, Frean, and Co., &c.

"That the Swiss and French watchmakers are the superiors of the English in real delicacy and purity of finish in the design of the exterior of their watches, and in complications, is an almost universally admitted fact; for a long time that has been their characteristic, and it is so still.

"English watchmakers have laboured hard to produce a machine that will measure time accurately; in that direction they have always carried the palm, *provided that they had a carte blanche as to price;* but the Swiss watchmakers, wise in their generation, have, without forfeiting any of their taste for a beautiful appearance, applied themselves of late years to produce a watch equal to our best English watches in point of timekeeping, and experience confirms the opinion that they have succeeded.

"Before concluding this report, I would for a moment contrast the French and Swiss systems of training their apprentices with our English system.

"The agitation which has been going on in this country for some time now in regard to Technical Education will, I hope, result in great good to our trade, for in no other trade in England is it more required; the ignorant state of a vast per-centage of our workmen in that direction is a most lamentable fact *and a disgrace.* When a youth is apprenticed in France or Switzerland he remains but a short time in the factory, some twelve months, more or less; he then attends such an institution as the one I have already spoken of, l'Ecole Nationale d'Horlogerie, where he has the benefit of lectures and classes, conducted by learned professors, and the teaching of practical men at the bench; here he remains from two to three years, when he again returns to the factory. Such a course as that cannot fail to make an intelligent youth master of his trade. How do we teach our youths their trade? How much do they learn during the first two years of their apprenticeship? In the majority of cases not much more than running errands and sweeping the floor of the workshop."

Timekeepers, Clocks, Watches, and Chronometers.

"Mr. Victor Kullberg, of Liverpool Road, London, exhibits chronometers of the above description in a state of all but absolute perfection, both as regards workmanship and timekeeping. They are the perfection of mechanism, and do not vary in time half a second for many months. Among the many excellent horological machines exhibited, I saw none equal to these. Besides these, Mr. C. J. Klaftenberger, of Regent Street, London, exhibits chronometers, timepieces, and watches of very excellent construction, having all the modern improvements. His watch-cases are extremely chaste and beautiful; the enamelled work is done by a new and less costly process. Specimens of this are shown in the crests of the Archbishop of Canterbury and the Duke of Bedford, beautifully enamelled on bassine edged cases. In the French department there was exhibited an excellent variety of clocks, watches, and timepieces of very superior quality, by different firms; Leroy and Brequet, both of Paris, stand conspicuous. The former shows timepieces with the duplex escapement, watches repeating the hours, chronographs with split seconds and duplicate dials, marking every division of time from a quarter of a second to the date of the month, and also the age of the moon, and all of first class quality. I cannot speak too highly of the timepieces exhibited by L. Brequet, of Paris, displaying as they do in their construction such originality of idea, versatility of talent, and superiority of workmanship combined, as I did not find under any other name in the Exhibition. 1st. An astronomical clock, striking the seconds at will, so that two or more persons can take observations at the same time. 2nd. A timepiece whose escapement is the vibration of a tuning-fork, recording accurately the hundredth part of a second, which keeps correct time and is regulated by a screw on the tuning-fork. 3rd. A regulator whose pendulum is of zinc and steel, that keeps time equal to one of steel and mercury, and is produced at a fraction of the cost. 4th. A timepiece whose lever action is on the right angle, enabling it to dispense with the objectionable contrate wheel, and bringing the balance into the horizontal position. And lastly, I will mention a remontoir clock, whose nine-inch-and-a-fraction pendulum shows seconds, and the workmanship of which throughout cannot be surpassed.

"In small complicated machinery the Swiss productions are unrivalled, and the house of Patek, Philippe, and Co. well represent their staple trade in this Exhibition. J. Huguenin Girard, of Geneva, exhibits a fine display of balance springs of all kinds; Bourgeaux and Delamure, of Geneva, a variety of excellent watchmakers' tools; and D. L. Petitpierre, from Couvet, Switzerland, shows a pitching tool with three sets of centres, and shows the pallet wheel and roller depths, in fact, the whole lever escapement is seen in it at the same time. This is a useful invention, and its advantage over the old tool, that can only show part of the escapement at once, cannot fail to be appreciated.

"Austria and Germany generally are very fully represented in clocks in the Exhibition. The regulator and hall clocks made in Vienna, I examined in detail, and found them the best I had ever seen; the metal hard, the workmanship square, and the finish on the pinions, arbors, and pivots, when examined through the eyeglass, faultless; the jewelling finely executed, and the arrangements of the pallets for giving nicety of pitch, exquisite. The house clocks from the Black Forest and other parts in Germany, though in beautifully carved cases, have rather coarse movements, not to be confounded with those high-class time-keepers manufactured in Vienna.

"Chronographs, or watches that mark time in writing by means of a miniature pen on the point of seconds' hand, are shown in large numbers, and much improved.

"In comparing the home and foreign work, for turret or large clocks, Great Britain stands first for quality and utility, and our system of manufacturing by steam power anything of bulk will always enable us to keep down in price where the orders are large enough to induce competition. Of hall or regulator clocks, Austria produces the best, and of spring clocks France has the best and most suitable for dining and drawing-rooms, or for mantel time-pieces. For chronometers, or lever watches, for time-keeping and quality, England is the first. For repeaters, or complicated watches requiring to give more than simply the time, Switzerland is unrivalled.

"The English watch cases are strongly made, but they are all alike or nearly so, with their everlasting engine-turned backs, so unsightly after a few years' wear, while the Swiss cases are embellished with the art of the engraver in lines and curves of beautiful form and combination; landscapes, animals, and vegetable life are subjects often represented, and form scenes the eye can dwell on with pleasure."

Design in Wood, Metal, and Stone.

Austria.

"On the floor of the Rotunda is a Gothic pulpit of very fair design; but it is made of cement. Now, we have been taught by some art teachers to abhor sham in everything, and if a warehouse were to be 'run' up in common brick, properly keyed and ready for stucco, it would be condemned; and is there any wonder it should? Have we not seen in numberless instances an ominous crack make its appearance in a stucco wall, in shape resembling a crow's foot; then the centre of the decaying portion appears as though it were gradually drawn outwards, like a flat pyramid, and some very wet day down comes a great patch of the front, leaving a speaking testimonial to the vile stuff the builder daubed on. This is not the case on the Continent. We look around, and find ninety-nine out of every hundred houses stuccoed, but there were no cracks visible, no large brown, mouldy patches, no corners knocked off, nor any appearance of sham. No lines drawn across and cut into the face of the plaster, to make believe that the building is of large, solid, square stones. It is used fairly as composition—a much cheaper commodity than stone, capable of quite as much ornamentation, and, mixed as they mix it, lasting a long time; in point of cost bearing no comparison with stone. It is to the general use of this material that we must attribute the substantial, respectable, and cheerful aspect of the streets of Dresden and Vienna, so unlike our narrow long perspective of brick cottage houses. Some of our very best furniture is veneered, and it is the better for it. Why should we not veneer our houses if we can obtain material that will last as long or longer than the brick on which it is hung? and so capable of ornamentation as it is, would it not be a step in the right direction?

"Birmingham is now supplying nearly all England with strong, light, easy-put-up and easy-taken-down iron bedsteads; but with all her variety in designs, we have yet to see those which will bear comparison with Austrian bedsteads here exhibited. They are made of sheet-iron, circular outline and elliptic fronted. One is a pure white ground, and finished as though it were French polished. A few flowers and leaves, beautifully arranged, form the ornament at the foot and head. The stocks are twelve or fourteen inches wide, and a sprig of flowers and leaves wanders the entire length. They look well, very simple, and very fit for a bedroom. There are also examples in black and gold and other colours. They make a much better appearance than the spider-web designs of the generally used class of iron bedsteads from Birmingham. The babies' cots were extremely pretty.

"Gebrüder Thonet show some furniture made from bent wood; the timber for the furniture is first cut in the direction of the grain and worked, then bent to the required shape by heat. The tables appear to be very well finished, but we cannot say that we admire their supports; they have too light an appearance, and must be too elastic to be solid and strong, setting aside the evil consequences likely to arise on exposure to damp. There is also here a portion of a circular staircase, built of bent timber, by P. Reimer; it is well adapted for this kind of work, and makes the strongest kind of staircase; the ease with which the rail can be wrought, and ornamental banisters filled in, all commend it as an improvement.

"Some of the wardrobes and cabinets are very well made, and have a very effective appearance, without the detail of flat ornamentation, which we generally put in our work. The designs for clock-cases are, in some instances, very good; they seem to display far better taste in this branch of woodwork than in any other.

"The wrought-iron work which I saw in Austria, with the exception of some in St. Stephen's, Vienna, is scarcely worthy of mention. Although to make an article or a building rather pretty seems to come naturally to the Austrians, yet I am bound to say that in that prettiness may be often seen an utter want of thought and careful study. Austria has much to learn, and there is no doubt she will make use of the splendid opportunities now afforded by the Exhibition of the Industry of All Nations."

Great Britain.

"Englishmen have the name of being the best workmen in the world, and they justly merit this good name, for every nation has vastly benefited by their dogged perseverance in the invention and perfection of machinery of all kinds. We are thoroughly a mechanical people; we do everything by square and straight-edge, and when we have completed a piece of work to our satisfaction, we proudly bring down our doubled fist upon it, and say *that's a good strong job*, forgetting all the time that there is such a thing as ornament. Our work always looks too strong, and full of sharp offensive corners; if we do ornament it, we do so by rule, and instead of clothing it with grace and beauty, we produce an ungainly article, innocent of anything but work. I do not say that this is always the case, but I do assert that it is the rule rather than the exception.

"Messrs. Jackson and Graham exhibit an ebony cabinet in Italian style, which for excellence of finish cannot be surpassed. I learn that the bottom part of this, with a marble top on, was at the Paris Exhibition, it being then in an unfinished condition. The front is divided into three compartments; between each of these is a pilaster, the fluting of which is stopped at about two-fifths from the bottom; the whole is built of Spanish mahogany, and is veneered inside and out with black ebony. There is a quantity of ivory tracery and lining in it, and the ends of the cabinet are quite as full of detail as the front. Anyone unaccustomed to this work cannot conceive what an immense amount of time and care is required in its production; two first-class workmen were fifty-three months each at this job. Look where you will—mitres, shoulders, or fluting stops—all is clean, close, perfect. All along the channels of flutes, and in almost every corner, is minute ivory tracery; the very shelves, which are concealed from view, I examined, and found them beautifully finished and engraved. Blue lapis lazuli is let in in various parts, which adds greatly to the effect; but in fact, were it not for the white ivory ornamentation contrasting so strongly with the ebony, the design would be tame.

"Here is also a cabinet table in Italian style, the little pilasters of which are surmounted by capitals full of almost microscopical work; every little mould, bead, and fillet is of different coloured wood; the groundwork of the panels is palm tree cut end-ways. Another cabinet, in pure Greek outline, is highly ornamented by different coloured woods and ivory, being inlaid in Oriental style. All these cabinets depend upon the ivory for their very beautiful appearance; this kind of ornament exhibited by other nations is miserably executed when compared with work so faultless as this is, and so full of chaste design.

"All the English furniture we have noticed thus far has one feature in common, that is, ornamented flat surface, the designs of which point to a refined taste in our midst, and artistic talent which will, if cared for and not confined to one particular rut, soon elevate us above the level of our neighbouring nations.

"Mr. Owen Jones shows some designs for couches, chairs, cabinets, &c., the prevailing feature of which is a combination of different-coloured materials arranged in Oriental style in flat surfaces.

"The British show-cases are by far the most beautiful ones in the Exhibition; perhaps our being a 'nation of shopkeepers' has tended to the cultivation of this particular branch of joinery work."

France.

"The foundation and principal feature of the French ornamental iron-work as shown in the Exhibition, is the spiral. There is nothing in their design to give the idea of strength; it

is all ornament—ornament seems to be the end and aim through all their work; we do not see any of that angularity so peculiar to our iron ornamentation. Baudrit, of Paris, exhibits some good iron work; it is impossible for us to do justice to the beauty and gracefulness of some of their designs in writing. There is one specimen of very light work, full of curling tendrils and scrolls; one of a little heavier metal and bolder design; one good large pattern of scroll work and acanthus leaf; and a first-rate specimen of iron and brass, used together—pattresses, flowers, oak leaves, and acorns very tastefully combined, and making a highly ornamental display.

"M. Goekler exhibits a bedroom suite, enamelled white with blue lines—it is plain but very neat; also a very good cabinet in ebony. The upper part of the cabinet is supported by trusses, which gives it a top-heavy appearance, but the work is exceedingly well done. P. Mazaroz exhibits a piece of furniture which is one blaze of gold; there are figures of boys standing against the upper part, and the front is nearly all occupied by a panel carved in relief; it is allegorical, and a proper specimen of French taste.

"Henri Fourdinois exhibits the best furniture of any in the French department; it is first-class both in workmanship and design. The gentleman in charge took from a drawer some specimens of breveté sculpture, light coloured wood let into wood of a darker shade; the light wood was carved elegantly and clean, and goes clear through the dark wood. The designs were very pretty.

"The conclusion that we arrive at, after examining their various productions is, that the French will allow nothing to stand in the way of adornment—directly opposite to the spirit we manifest; if they cannot combine utility with beauty, they will have the latter at the expense of the former. No other nation decorates so much and so extravagantly as they do; coloured woods, ivory, and enamel, metal of all kinds, arms, horses, and chariots, shields, scrolls, flowers, birds, and beasts, figures celestial and terrestrial, are all laid under tribute to beautify the work of their hands and gratify the national passion for display."

Germany.

"Our fireplaces are much more comfortable to sit around, and far pleasanter to look upon, than the ugly closed stove, and Germany is successfully emulating us in this matter. I have often thought what ungainly and smudgy looking things our firesides were, the very ugliest part of the whole house; and of all places, the one to which we draw up our easy chairs and stare at all evening long, why this should be the prettiest nook in all the building. There is a good marble mantel and a very ornamental brass stove or fire-place, something to look upon with pleasure, though it is not as good as that exhibited by Yates, Haywood and Co., of London. It is high time we altered our crude taste in such articles; and if we cannot dispense with them altogether, as many Americans do, let us at least adopt something more pleasing than blacklead and its associations.

"Some of the cabinets display much taste in design. Where we should fix a plain pilaster, they carve a figure; where we let in a tile, apparently painted 400 years ago, they carve fruit, leaves, or flowers. Here is a very good Gothic cabinet, of very excellent design, with engraved glass panels, thick silvered hinges, escutcheons, &c. With all our pretensions to Gothic, it certainly shames any such as we have seen at home. Also a black ebony cabinet, on which the ornament is profusely heaped. In the lower part three figures do duty for pilasters, and in the panels trophies are carved; the mouldings are all beautifully enriched. Three female figures support the shelf above, and in the panel of the back a stag hunt is carved. The cornice is supported by male figures. This piece of furniture will bear close inspection by workman or artist."

Italy.

"The matchless skill and beauty of a specimen of wood carving I much appreciated. It is a panel carved in relief, about 3 ft. long and 1 ft. wide. The centre figure is a female, her hair streaming in the wind and she standing in a shell; a lovely little cherub, all wings and head, is lightly touching her lips, and clusters of cherubs are hovering round her. The slenderest of stems and leaves emanate from the centre in perfect curves, forming a network regular in outline and charming in design. Here and there those elegant curves dash boldly to the front, magically changing their character into a dragon, not marring, but adding to the effect, like a clear and gentle purling brook suddenly leaping over a rock and transforming itself into a foaming cataract.

"The cabinets are of a very bold design. Blue, red, and green stone are much used for inlaying, and very often bold carved figures of unexceptionable outline are introduced. Table tops are frequently inlaid with different coloured marble, representing vases, musical instruments, scrolls, dolphins, birds, angels, fruit and flowers in unlimited profusion."

Switzerland.

"A very fair sample of circular stairs in cast iron. The treads and risers are riveted together; then these are riveted to sheet iron outside string. On each step are two banisters, one twisted and one straight. The twisted one goes right into the underside of the rail, and when the straight one reaches nearly the top, it bends into a scroll with leaves, forming an ornament all along the underside of the rail.

"Close by the annexe is a Swiss house, which gives us an excellent idea of their design in building. A balcony runs all round the house, and the roof projects sufficiently to cover it. Carved and twisted pillars support the wall-plates, and wherever there is a right angle there an ornamental bracket is fixed, cut out in some fanciful manner. The house is built of deals, planed and dowelled together, the ends project, and are gouged out to take away the plainness. Inside the house the risers of the stairs have strips tacked on diagonally across their whole face, and the banisters are cut out with a bow-saw. The architraves and panels of the doors are ornamented with strips of walnut, cut out to patterns, and nailed on, and sometimes they are carved. The work is all extremely rough, but the general effect is very pleasing.

"Here are workboxes, knives, forks, spoons, baskets, vases, toilet glasses, barometers, clocks, crosses, chairs, tables, dogs, stags, all in endless variety, and carved out of dark-looking wood. There is a loo-table with a beautifully carved top in slight relief, a very Swiss notion, and quite contrary to our ideas of utility."

Spain

"exhibits a very good sideboard of dark oak; it is about 8 ft. long and 10 ft. high, and about 2 ft. from back to front. The carved panels and figures are of much lighter wood, which rather mars than enhances the good effect. On one panel is a boy amusing himself with ducks, and on either side of this is a group of birds. In the centre of the back is a youth feeding a bird, which is perched on his shoulder; the lower panels are filled in with carved fruit. The handles to the drawer fronts are very pretty; they consist of two sprigs with leaves intertwining, and bending out a little in the middle to afford hold for the hand.

"Very near this sideboard stands a cottage piano, which, viewed at the distance of three yards, looks like a packing case, with brown paper pasted over it. On closer inspection we find it is carved most elaborately in geometrical arabesque. A more complete waste of labour and a more wretched perversion of taste it was never our lot to behold. In their designs they pitch their pearls to the swine with a vengeance."

Egypt.

"There cannot be a greater difference visible in anything than is shown in the designs of the ancient and modern Egyptians. The monolithic and sepulchral style of the Pharaohs, the crocodile, the beetle, and the water-lily, and the hieroglyphic writing which covered their walls, all belong to ages long since passed away; and in their place we find the dome, the minaret, the crescent, and the unscientific arch and coloured embellishments of the Mussulman.

"There are two ebony cabinets here shown, very Moorish in style, with ivory and mother-of-pearl inlaid over their whole surface. The centre is a cupboard, and at each side is a niche overhung by a cusped arch; the frieze at the top is filled with rows of cusps, and the panels of the doors below are filled in with arabesque on a gilt ground."

Persia.

"They exhibit a table about 6 ft. long by about 3 ft. 6 in. wide, and standing on legs halved together and braced by a rail underneath, which goes through the halving, and is made firm by a key-wedge. It is miserably constructed, and is covered with red, green, yellow, black, and brass dots for ornament.

"There is a bedstead to match the above. It stands about one foot high, with a rail running completely round it, and a gate at one side to go to bed through. The legs have a triangular block nailed on them at the bottom and another at the top, for strength's sake; and on each post, right at the top, the paper photograph of a European girl is stuck on with gum."

Japan.

"There are several models of houses, most of which are quite open at the bottom, with a light palisading or network of bamboo running from post to post; the object of this will be to receive

as much of the cool air as possible. The lines of the eaves have many irregular curves in them, which adds considerably to their picturesqueness. They are thatched or shingled, and bamboos are then nailed diagonally upon them. Some have paper windows. Their houses, furniture, clothing, pictures, are all possessed of the same irregular outline, and they are not without beauty.

"They have been trying their hands at a chest of drawers and cupboard, but they will not pass muster.

"There is a very fair dining-room suite in frame, but we have a strong suspicion that they have been put together by a European, if not an Englishman, and the carved part only executed by them.

"They are a long way behind in many points, and yet they are worth imitation in some others, and may be studied with profit."

China.

"Here is the most extraordinary bedstead we ever clapped our eyes upon. It has four long posts, and the stocks are about six inches wide and one foot high. The mattress is about twelve inches thick, and moulded like an ogee on the sides. The width of the bedstead is considerably more at the head and foot than it is in the middle—the inference being that Johnny reposes with arms and legs outstretched. The posts are about two and a-half inches square, and the corners nicely rounded off; at about six inches from these are smaller posts, about one and a-quarter inch in diameter. The cornice is nine inches deep and beautifully carved. Very light carved work also answers the purpose of curtains, and sweeps from the top at the centre of the sides to about half-way down the posts. The character of their carving is peculiar, very minute at times, and very well finished.

"Also a toilet-stand, with ebony top, and three frightful dragons lashing themselves around the pillar. There is another with a quaint picture on the top, representing a procession of grasshoppers: six of them are carrying one of their brethren in a sedan chair—and very solemn they look over their job; another has his work set to lug along a flower and keep it perpendicular; six more are marching along in state, &c. The whole, probably, refers to some national fable.

"One piece of furniture very much resembles our canterburies; the shelves are surrounded with curious carved work, and fearfully Plutonic little figures are scrambling round the pillars.

"There is also a grim old specimen like a side-table; the two front legs are figures, the faces of which are just discernible."

The next three articles, by Messrs. John Campbell, Robert Cornthwaite, and Charles Grindrod, all treating of the exhibits connected with cotton, and going repeatedly over the same ground, may, for the purposes of our epitome, be regarded as one article, from which we extract the salient and novel features.

A Survey of the Exhibits connected with the Cotton Manufacture.

The Cotton Exhibited.

"For obvious reasons, the United States of North America first claim our attention, and they have indeed furnished an interesting exhibit of the various qualities well known in the market. The Mobile (Alabama) Cotton Exchange, as well as that of New Orleans (Louisiana), were well represented, the latter exhibiting nine sample bales accompanied with statistics. Besides these collective exhibits, and those of several private firms in the above-named states, there were samples from St. Louis (Missouri), Lee County (Mississippi), and Uplands from Memphis (Tennessee). Independent of these native exhibitors, several firms in England and other countries exhibited North American cotton from the bale, and in its various stages of preparation for manufacture.

"The United States of Venezuela exhibited four sets of samples of superior-looking staple, the best looking being Sea Island from the plantations of Tocoran, on the coast of Valencia; then came fine cotton from the valleys of Aragua, the State of Barcelona, and that of Yaracuy.

"The Brazilian Empire had a gigantic display of the cotton cultivation of its various provinces. The Town Council of Pernambuco, in the province of that name, sent samples of herbaceous cotton (*Gossypium herbaceum*), and several planters in the province of Bahia exhibited samples of the same kind, with black seed, several samples of green and yellow Maranham, independently of the usual sorts well known in the market by the names of the provinces where they are grown,—*i.e.* Bahia, Pernambuco, Maranham, St. Catharina, Amazons, Parana, &c.

"The British colonies or possessions that sent raw cotton were few, the largest exhibit being from India. The local committee of Berar, for the Government of Bombay, exhibited upwards of 700 samples of the produce of Western India, consisting principally of cotton, cotton seeds, and goods. The local committee of Indore exhibited the produce of that locality. There were several small bags from the Cape of Good Hope, and a collection of samples from Australia, including cotton grown in the Botanical Gardens, Brisbane, as well as some from Moreton Bay, grown from New Orleans seed, and classed as 'good fair,' at 9½*d.*, 9¾*d.*, and 10*d.* per lb.

"The French possessions and colonies were exceedingly well represented, Martinique, Guadaloupe, French Guinea, Senegal, West Coast of Africa, Island of Réunion, New Caledonia, French India, Cochin-China, &c., all sending samples, with no less than eight exhibitors of Tahitian, and four times that number of Algerian grown cotton; the thirty-two lots from Algeria, with three exceptions, being what the French spinners call 'Georgia Long-staple,' or Sea Island. On close inspection these samples would bear favourable comparison with American grown cotton. The following statistics were posted to this exhibit. 'There was exported from Algeria in the year

1868	376,982	kilos.	of	long-stapled cotton.
1869	282,584	„	„	„
1870	346,899	„	„	„
1871	271,479	„	„	„
1872	241,362	„	„	„

1,519,306 kilos., or 3,418,434 lbs. of cotton,

little, if anything, inferior to North American Sea Island.

"From Italy the Royal Industrial Commission of Turin Museum and the Exhibition Commission of Caserta had collective exhibits of Italian grown cotton, and thirteen private planters had fair specimens of European cotton, *i.e.*, Italian.

"Greece had five exhibitors of cotton in the pod, and many provinces of the Ottoman Empire sent very good samples.

"The Government of the Khedive of Egypt had a collection of thirty-five different sorts, several of them approaching, in appearance, to good Sea Island. Annexed to this exhibit was the following:—'Exported from Alexandria in

1821	944	quintaux, or	105,728 lbs.
1872	2,013,433	„	„ 225,504,496 lbs.

"The neighbouring states of Tunis and Morocco were represented with good samples. There was yellow-flaked cotton from Roumania; and from far away in the East—Siam, China, Japan, and Persia—came samples of the plant, which these nations cultivated and manufactured long ages before the great cotton-farm of the world—North America—was known to civilization.

"It will be seen from the foregoing, that nearly every nation, or, more properly speaking, the inhabitants of every settlement, as well as those of the continents, where climate and other conditions of nature are favourable, cultivate with assiduity a plant which has supplied the means of raising this country to a degree of prosperity never before attained by any nation; and that by giving judicious encouragement to those countries where cotton can be advantageously cultivated, England need never again be at the mercy of the United States of North America for her supply."

The Machinery used in the Cotton Manufacture.

"When a bale of cotton is opened, it is found that some few seeds, with a considerable admixture of leaf and dust, remain even after the ginning process, and as the cotton has been very closely pressed together to form a bale, an opener is required to break up these compressed tufts, and bring them into a fleecy condition. One opener exhibited is identical in construction with that made by Messrs. Crighton and Co., Manchester. This was a 'single machine,' intended to put through about 18,000 lbs. per week. It is not made, however, with Crighton's recent improvements to deliver the cotton in the form of a lap. It has a vertical cone-like beater, which revolves about 1,800 times per minute. This is surrounded with a grid, which allows a great area of cleaning space. The cotton is not held with feed rollers to the beater, but goes in at the bottom and out at the top.

"Messrs. John Jacob Rieter and Co. have a cotton opener of their own design also, which they say is specially intended for long-stapled cotton. The cotton is spread on a lattice feed cloth, at the extremity of which it is taken hold of by a spiked roller. Over this roller is placed a 'shell' (as in Tatham's card engine). The cotton is taken from the edge of the shell by a cylinder, about thirty-six inches in diameter, having eight rows of knife-shaped teeth, which project about one inch. These knives are not intersected with plates. The cylinder revolves upwards from the shell, and is surrounded with a grid, through which the sand, leaf, and seed are driven into an outer case, which surrounds the whole. The cotton is delivered in a loose form after it has passed nearly round the beater.

"The only 'gin' at work in the Exhibition is made by

Messrs. Platt, Brothers, and Co., Oldham, and it is called the 'patent double-roller gin, with hopper feed.' This machine certainly does its work well, taking away every fibre from the seeds, and delivering the cotton clean and open, so much so that it could at once be put into the breaker card. The following is Messrs. Platt's description:—'This machine is well adapted to separate any description of cotton from its seed, but especially so to the class of cotton adhering to seeds having the husk, or shell, covered with short fibres, technically termed woollen seeds, of which American uplands is a principal variety. The roller gin has hitherto proved inefficient for this kind of cotton, in consequence of the seeds, after separation, becoming entangled with the seed cotton, and obstructing the action of the roller and knives.

"'In the machine exhibited, this is obviated by the combined action of the moving and fixed grids. At each elevation of the moving knife the grid, which is attached to the same, lifts the cotton to the level of the fixed knife-edge, and to the exposed surface of the roller, and on the descent of the moving knife the seeds, which have become separated from the fibre, are disentangled by the prongs of the moving grid passing betwixt those of the fixed grid. The action of the rollers and knives is also shown by a full-sized model. The out-turn of clean cotton of this class is about 120 lbs. per hour, but of cotton having smooth seeds, as much as 200 lbs. may be obtained.'

"There is only one firm exhibiting the whole process of preparing and spinning cotton, viz., Joh. Jacob Reiter and Co., cotton spinners, machinists, &c., Winterthür, Zürich, Switzerland. This exhibit consists of all the usual machines, scutcher, &c., lap machine, first and second carding engines, drawing frames, slubbing frame, two intermediates, fly frame, and self-acting mule. Of this machinery there is absolutely nothing whatever to report on as being new in England, whatever may be the case elsewhere. On the carding engines there is Messrs. Dobson and Barlow's patent self-acting stripping motion, and John Hetherington and Son's patent coiling motion, the latter being also on the drawing frames; these motions are working on the machines referred to, without any mention being made, so far as could be seen, of the patentees or their property."

The Power Looms Exhibitea.

"There were looms from various parts of Germany, Austria, England, and one from the United States. The last claims attention on account of 'Ross's independent shuttle motion,' which is, at the same time, simple and ingenious. The inventor states that it can be driven at a speed of 300 picks per minute. The pickers are perpendicular and are worked by two heart-shaped wheels on the driving shaft; being pressed back alternately, each picker is forced into its place again by a series of spiral springs, acting independently on the shaft, which keeps the picker in its place. This loom is driven by a patent friction pulley, which fits inside the pulley driven by the strap, and as soon as the loom knocks off, through the weft breaking or otherwise, it stands instantaneously still. This loom was in motion, but no warp being in, no definite opinion can here be given of its capabilities.

"In the French section we have nothing to report, but from Switzerland we have a complete preparation of cotton spinning machinery. The first machine is a cotton-opener, which, in every respect, resembles Crighton's patent cotton-opener, as made, and extensively used, in this country. The scutcher has the appearance of the one made by Lord Bros., Todmorden, and has Lord's patent regulating feed motion. The lap, motion, fan, box, and general appearance is very good. The carding engines are of the same size and construction as those in general use in Lancashire, and have good long stapled cotton, carding very light, but contain no new feature. The drawing frame has three heads and three deliveries, six rows of fine fluted bottom rollers, six rows of leather top rollers, which are not weighted separately, but with a lever weight for three or more rollers, which must have a very bad effect on the drawing.

"The slubbing frame has three rows of fine fluted bottom rollers, three rows of top leather rollers, which are weighted separately, and run slowly with the fly leading the bobbin, and making a short draft. The intermediate and roving frames are much the same, with the exception of the bobbin leading the fly in the latter case. The mule runs slowly and rather heavily, although it has not a heavy appearance, and has three rows of double-bassed rollers, weighted separately. The mule-head looks well, and contains nearly all our latest inventions. Spins 36, with a draught of about 6, and speed of about 3½ draws per minute.

"The principal German exhibitors were from Chemnitz, in the kingdom of Saxony. In this department there was a loom from Reutlingen, in the kingdom of Würtemberg, with a revolving shuttle-box, having a striking resemblance to that of Mr. George Hodgson, of Bradford.

"If we are rightly informed, Messrs. J. J. Rieter and Co. are our most formidable opponents as makers of cotton manufacturing machinery. If this statement is positively true, and their preparation of machinery as exhibited is to be considered the most perfect and complete of all the machinery made on the Continent, no one would have any hesitation in saying that Lancashire still holds the first position.

"Without hesitation it may be safely affirmed that, for both plain and fancy work, the looms exhibited by Mr. George Hodgson, Thornton Road, Bradford, Yorkshire, were (if equalled) unsurpassed by anything in the Exhibition."

The Cotton Manufactures Exhibited.

"From the United States there was one exhibitor of yarn, from St. Louis (Missouri) another of yarn; thread and cloth from New Orleans (Louisiana); one with shirtings from Providence (Rhode Island), and another from Boston (Massachusetts).

"From the Brazils there were three exhibitors:—One of yarn from the province of Bahia; the others were calico and sailcloth from the province of Minas Geraes.

"From England there were about a dozen exhibitors of yarns, sewing thread, crochet and embroidery yarns, &c. The exhibits of this class, which appear to be the most complete, were respectively that of E. Ashworth and Sons, Bolton, who exhibited fine cotton in all stages of preparation from the bag to the mule, and single yarn on cops from 18's to 220's, bleached, dyed, and polished yarns and thread; Messrs. Brook, of Huddersfield, who exhibited what is known in the market as six-cotton sewing cotton, and patent glacé yarn; John Dewhurst and Sons, Skipton, who exhibited specimens of the manufacture in its various stages, and sewing cotton, bleached and dyed; Messrs. Bowman, of Halifax, who had a similar exhibit. There were no less than five or six Paisley thread firms represented. Coarse spinning was illustrated in its various processes by T. Ogden and Co., Oldham, with cloth, banding, sewing, and knitting cotton, and fishing nets, &c.

"From Portugal there were nine exhibitors, two of yarns and seven of cloths, &c., the principal being the Spinning and Weaving Company of Lisbon—coarse yarn and cloth; and the Porto Spinning Company—thread and yarn.

"Spain was represented by eleven or twelve exhibitors of plain and printed cloth, principally chintzes, but no yarn.

"There were ten exhibitors from France, five of yarns and thread, and five of cloth. H. Loyer and Sons, Lille, appeared to have the finest thread. Besides these there was a collective exhibit of thirty-eight firms from Farare (Rhône), consisting of plain and embroidered muslins and window curtains, figured and embroidered muslins by the loom, dyed and finished muslin, and embroidered goods.

"Switzerland was represented by no less than forty-eight exhibitors of yarns, thread, and cloth. Nine of these exhibitors put their Turkey red dyed yarns prominently forward.

"There were eight exhibits from Holland, yarn for candlewick and heavy goods; the most important exhibit being that of the Hilversumche Steam Spinning and Weaving Company, Amsterdam. Three exhibitors described their goods as being manufactured for export to British India and Java.

"There were exhibits from nearly all parts of Germany, amounting in all to nearly a hundred; the principal being from Saxony, the finest-looking being that of the Saxon Sewing Thread Company, who showed the various processes of manufacture from raw cotton to thread.

"The Russian Empire was represented by twenty-eight exhibits of cotton goods and yarn. The first glance at the Russian manufactures brings the conviction that they are not novices in the trade.

"With regard to the manufactured goods, any unprejudiced Englishman would place this country's exhibits, poor as they are, in the very first rank for yarns, thread, and Turkey red dyed goods, bleached calico, shirtings, and printed handkerchiefs; for small wares nothing could surpass the exhibit of Messrs. Waters, of Manchester. With regard to so many exhibitors of sewing and other threads, he will be a clever juryman who can give a casting vote to decide the honour, where all are honourable. Wishing to avoid as much as possible the mention of particular firms, reference is requested to the names mentioned when noticing the exhibits of different nations. The principal object of this Report being understood to be to point out the true position of England to other manufacturing nations, and not to prefer any particular exhibit to another, I shall proceed to name in rotation our greatest rivals, and endeavour to ascertain if we can keep the lead in the clothing trade of the world.

"Next to England France claims our attention for the beauty and excellence of her cotton manufacture, more particularly in the finer class of yarns and cloth; and it is gratifying to see that France, to whom science owed so much in the days of her pros-

perity, has not neglected scientific industry in the dark days of adversity. The first spinning machine was introduced into France from England in 1787, and the cotton manufacture was fairly established there in 1798,[1] and the French have certainly made much progress in three-quarters of a century, many mills in Lille spinning from 200's to 400's regularly; but they excel most in the beautiful designs of their prints.

"For the lower or medium numbers of yarn, it would be very difficult to decide between Belgium and Switzerland; the work-people of both countries are equally sober and industrious; if there be any difference, however slight, it is in favour of the Swiss; but the finest yarns, as a rule, are spun in Switzerland. The representative of one firm assured the writer that they had themselves twenty pairs of mules, of 400 spindles each, spinning No. 200's and upwards regularly, and occasionally much finer when they had orders.

"Russia comes next on the list, not so much as a competitor against us in other foreign markets, but as a nation that can supply its own wants, and do without us; up till now their manufacture has been done by English-made machinery, and superintended by English intellect.

"With regard to Germany, or, rather, the German Empire, Saxony alone produces anything at all equal to English goods; the other parts of the empire, although manufacturing fine goods, get their yarns from England.

"The same may be said of the Austrian Empire, with its component parts, Bohemia and Hungary; it is questionable if anything fewer than 40's be spun in the whole country.

"Of the other European nations who exhibited cotton yarn and goods, they may all, with the exception of Italy, be eliminated from the present enquiry, and the opposing forces will then be reduced to England, France, Belgium, and Switzerland, as the suppliers of cotton goods to all the other markets of the world."

Calico Printing, Dyeing, and Bleaching.

"Whatever may have been the cause of this apathy, it is clear other nations do not share it. Austria, as might be expected, exhibits well in many departments, and in others but indifferently. In Group V. there are a number of handkerchiefs, chiefly block-work, mixed with cotton prints of the most common and simple designs, composed of set objects, plain stripes and small checks. Against this may be contrasted the contribution of Albert Reiss (No. 309 of the same group), whose elaborate designs of flowers in trail stripes, with neatly executed pin-shading in various colours, is above the average merit, and the dyeing and printing of which are very creditable.

The display of "doppel cardirt" is very fine, consisting of large samples of cotton wool, in various stages of manufacture, perhaps equal to any in the Austrian Department. Bleached and dyed yarns and cotton fabrics are in profusion about here.

"Torrens and Co., Mulhausen, exhibit well in unbleached goods, along with some furnitures, the designs, printing, and colours of which are really good. Schlumberger and Sons, Mulhausen, have similar articles, with no striking difference in workmanship, but first class throughout, the furnitures being a really grand display; and from the position of the case, aided by the skilful arrangement of the prints, the goods are seen to great advantage. They have excellent cotton wool, chiefly American, with cops, dyed thread, and printed trouserings on a kind of moleskin cloth, and fine plush velvets dyed in various colours, the tone and blending of which are of great richness; they are printed in from ten to twenty colours, both glazed and crétonne.

"The Russian Court is dreary and tasteless, though Russia exhibits very creditably, with printed goods, Turkey reds, printed trouserings, and dyed shirtings.

"The printed handkerchiefs of Hubner, of Moscow, are of a superior character. Some other cases in this Court are very uninviting, with cases squared and centred, from which long hard lengths of cloth are tightly drawn and puckered, without any regard to colouring or ease; and others in this place are unexceptionably stamped with the same incapacity and want of grace.

"The Ottoman Empire has some remarkably fine samples of cotton wool, but the cloth is coarse and badly bleached. In connection with these are some curiously wrought fabrics, interwoven with loose threads about an inch in length, and working out, in some instances, especially where the metallic wire which they use so commonly is judiciously applied, a few elegant designs. Egypt is poor in cotton goods, but abounds in the raw material, showing very effectively the silken and beautiful character of the raw cotton.

"Italy sends a rather meritorious class of goods, considering the difficulties of her past existence. Cotonificio Cantoni.—This is a neat and artistically finished case of bleached and dyed goods—from the raw material to the finished article; the cotton of which appears rather poor, probably Egyptian. With brocades are some excellent dimity fabrics, the figures of which stand well up; also some dark dipped blues and printed block work, very fair.

"Spain exhibits well in printed goods and calicoes generally. Catuluna, Picart, and Co., Barcelona, have a fair collection of prints, chiefly light things; printing not bad, but finish very poor. Some oxide of chrome, plain shades, look pleasing, and are tastefully arranged. José Ferrin and Co., Barcelona, show mostly light work of good quality and style, stripe patterns prevailing; the way these goods are set out is really fine, and does great credit to the firm. Santonja e Hijos, Barcelona, show dark patterns, consisting chiefly of dip blues in the old style, blue, orange, and white, and a few small handkerchiefs with buff ground; altogether a very fair collection. From Achon, Andalusia, are two cases; one small, and not satisfactorily set out, with cloth and work generally good; the other, in the course of fitting up, poor and tawdry.

"China has nothing competitively alarming. She appears to be more on the defensive than otherwise. All her coloured articles seem as if they had been selected from some museum, as representing some ancient but extinct dynasty. No calico prints to be seen. British India exhibits some poor cheap prints for purposes of covering. The object of the manufacture of these fabrics is honestly stated to be cheapness; but whether it is truthful to call them Indian prints I very much doubt. They appear to be British goods manufactured for India. If so, they should have been found in the British Court. Here they would be distinguished as the only representative of the printing trade of England.

"The following are the wages of skilled artisans and labourers in connection with the printing business in Austria, Germany, and Russia. The rate of wages in Austria is generally a little less than in Prussia; the machine printers average about £2 per week in the latter place, but somewhat lower in Austria, though they work longer hours. Back-tenters, bleachers, and dyers, and other unskilled hands, 90 kreutzers per day—nearly 2s. English money, or about 11s. per week: time, from 6 A. M. to 6 P. M., Saturday included; the breakfast being taken without any specially appointed interval—that is, they eat it during their working hours; one hour for dinner.

"In Russia, printers' wages are £2 per week. Back-tenters and dye-house men and other labourers average 15 roubles per month, equal to £2 10s. Engravers average about £2 5s. per week: time, from 5.30 A. M. to 8 P. M.; in some print works from 5 A. M. to 8 P. M.

"In calculating the time worked at the respective print works on the Continent, we can safely deduct half an hour for the time consumed in eating their food, which would make for Austria and Prussia 63 working hours per week.

"The Russian print works, on the other hand, work 81 hours per week, exclusive of one hour and a half for meals. There is one exception to this rule at a print works in the vicinity of Petersburg, where the hands work 75 hours per week, closing at 2 o'clock on the Saturdays. The owner of these works, I am informed, finds it to his advantage to do so."

(*To be continued.*)

[1] Dr. Ure's "Investigation into the Cotton Manufacture of Great Britain."

APPARATUS FOR EMPTYING CESSPOOLS.[1]

WHILE the system of sewerage, or water carriage of night soil, as a means of removal, has been largely adopted in the more advanced cities of the world, still by far the larger portion is deposited in vaults and cesspools; to the sanitarian, therefore, the question of how this refuse shall be removed from such receptacles, without that violence to the senses and to decency, and without that detriment to public health so long tolerated as an inevitable accompaniment of the well known and well nigh universal bucket system, is one of no small importance.

Up to the present time none of the various methods proposed have been largely adopted or attended with substantial success,

[1] From "The Scientific American."

APPARATUS FOR EMPTYING VAULTS AND FOR THE REMOVAL OF NIGHT SOIL.

although the most plausible solution would seem to be the use of some means of conveying the soil to an airtight tank without agitating or exposing it to the open air.

The principal mechanical difficulty has been the inevitable obstruction and choking of the valves and working parts of the pumps usually employed, by the innumerable odds and ends that find their way into the depository. Strainers for excluding everything from the pumps except the more fluid portions have been found of little avail, as the material, with its obstructions, is not only not removed, but is as much a clog to the strainers as to the pumps.

Various pneumatic systems have been proposed, and several methods of exhausting the tanks have been employed, among them the use of air pumps worked by hand or steam; or when attached to the tank, such pumps have been made to exhaust the air from it by being geared directly to the wheels of the tank, so that while it was being drawn through the streets to the vault, the air would be exhausted and the tank be in readiness for filling.

In other cases exhaustion has been effected by injecting steam or heated air into the tank, and subsequently condensing or cooling it, or by filling the tank with water and discharging it through a tube, having its outlet some 35 or 40 ft. below. All of these systems, though excellent in theory, have encountered many practical difficulties. What is needed is a pump so constructed as to raise and force, by direct action and without obstruction to its working parts, the contents of sinks and cesspools, just as they occur. To this must be added the requirement that, in discharging the matter into the airtight receptacle, no offence be created by the escape of noxious gases.

Such an efficient direct-acting pump, an airtight tank, and a deodorizing attachment are claimed to constitute the prominent features of the system of the "Odourless Excavating Apparatus Company," about to be described. By this plan we are informed, the operation is performed during the working hours of the day, not only without offence, but with the greatest efficiency and despatch.

The chief point of novelty in the pump employed lies in the valves. Virtually, these appliances, by their construction and positions in the pump, form a continuation of the connecting hose leading from the vault to the tank, and, being in direct line with each other, offer little resistance to the passage of the material. The valve shown in the sectional view of the pump, fig. 2, and in the smaller engravings, figs. 3 and 4, is made of soft, elastic, vulcanized rubber, A, tubular in form; and being composed of two flat pieces placed face to face and riveted together at their edges, is, in its normal condition, collapsed. Its length is equal to some three diameters when open. One end is distended, and, embracing a collar, B, that surrounds the port, is securely fastened thereto by clamps and bolts. There is, therefore, a collapsible tube, one end of which is permanently distended to embrace the port through which the material passes. This passage, in one direction, is direct and unresisted through the valve, while it cannot take place in the opposite direction by reason of the collapse of the tube by the pressure on its sides. The valve, being of much greater length than diameter, presents an extended bearing or contact surface between its two sides, and therefore closely engage and surround whatever obstruction may be passing through it at the time of its collapse, forming about the obstruction an airtight joint, fig. 2. At the succeeding stroke the valve is again distended, and the obstruction passes forward without in the least interfering with the action of the pump. Each valve is provided at its base with rigid straps or braces, C, which prevent it from being forced into the port by external pressure.

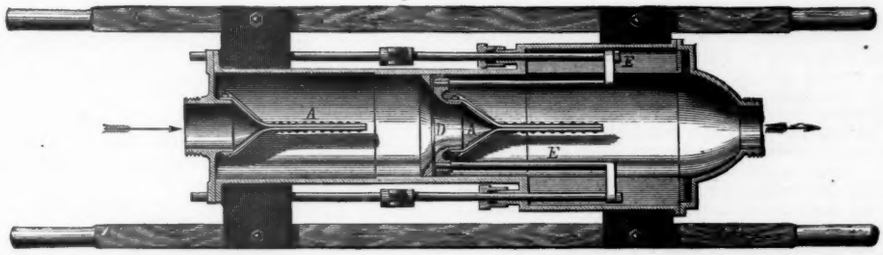
The pump is single acting (fig. 2), and in form a straight cylinder, provided with one fixed valve (the induction) and one moveable, both marked A in the engraving, the latter attached

to the piston, D, moving in the centre of the cylinder. The passage of the material through the pump is therefore direct and without counter currents; and such is its capacity for passing obstructions that we have seen large pieces of cloth (and it is stated, an entire pair of heavy cloth pants may be) pumped through with ease. In fact, any obstacle not too large to enter the suction hose, and of whatever length, will pass freely through the valves without interfering with their action. This capacity for passing obstructions renders the use of a strainer on the end of the suction hose superfluous, and it is used with a clear, free opening. Usually this will not become obstructed, the hose being of three inches inside diameter; but in cases where a large quantity of tough and tangled material is present in the vault, such as masses of shavings and rags, a curved foot pipe is used, having an opening on its side of the full capacity of the hose. Should an accumulation of tough materials occur at this point, it is removed occasionally by the action of a sliding blade or cutter, attached to the foot pipe and operated by a rod. This device is only used in the worst cases, but by its use the capacity of the apparatus is greatly increased, and it is under more perfect control.

The rods, E, moving the piston, are placed at the sides of the pump, and do not obstruct the opening through it.

For convenience, the pump is mounted on wheels placed at

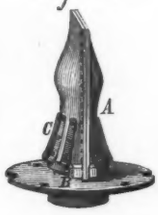
Fig. 2



the centre. When in position for work, it stands at an angle of some thirty degrees elevation, and is conveniently operated by the brake or lever. By reason of its inclined position, the air contained in the pump is displaced with facility and the valves retain their charge. The pump, therefore, seldom requires priming, even when used to raise the material a great distance. Two props in front serve to support the pump firmly while being operated. They are closed in when not in use. The balancing of the pump on two wheels at the centre also renders the discharging of its contents and cleaning very convenient, by reversing the inclination, in which position it may also be readily charged, when necessary, through the induction port, the discharge being closed.

Fig. 3.

Fig. 4.



The couplings F, used for connecting the sections of hose together and to the pump and tank, are of novel construction and designed especially for this purpose. Those attached to the pump and tank are furnished with fixed wrenches, by which the connection is quickly and perfectly effected. When the hose is detached, both portions of the coupling are sealed with suitable caps, and the entire apparatus rendered airtight. The receiving tank used is of ordinary construction and provided with inlet and discharge openings, and also with an indicator for showing correctly the quantity of material contained. The action is said to be sensitive and accurate.

A flanged collar, attached to the top of tank, supports the charcoal furnace in which the noisome gases, displaced from the tank while being filled, are deodorized and rendered inoffensive. This form of deodorizer is employed as being the most efficient and economical The purifying action of the fire is intense, and the displaced gases, after passing through it, are entirely without odour.

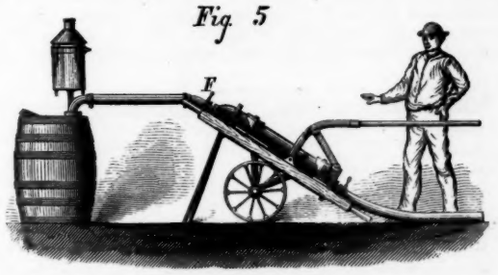
In addition to its use for removing night soil, the apparatus is claimed to be equally efficient in removing the contents of sewers and traps in a like inoffensive manner.

The original patent for the use of the deodorizer, in combination with an airtight tank, for cleaning sinks and cesspools without offence, was granted to Louis Straus, January 28th, 1868, but the apparatus has been in very limited use, owing to the inefficiency of the pumps heretofore designed for use in connection with it.

The patent on the pump valve was granted to William Painter, of Baltimore, August 5, 1873. Patents on other portions of the apparatus are now pending, and the company is about to apply for patents abroad.

The apparatus, we are informed, has already been adopted in the national capital to the entire exclusion of the old bucket system. The plan there employed is represented in fig. 5, the soil being pumped into barrels fitted with the deodorizing furnace. It is also in successful operation in Baltimore, and negotiations are now pending for its introduction in other cities. Our large engraving will give an excellent idea of the complete apparatus as it appears in use.

Fig. 5



BELLS, BELL METAL, AND BELL FOUNDING.

[POSTSCRIPT.]

IN our recent article on this subject (vol. iii. p. 84), a statement was made to the effect that the largest bells in the world, next to those of Russia, are to be found in China, at the cities of Nankin and Pekin. A traveller, whose narrative has lately been published, gives a very interesting description of a bell of vast dimensions, in a country little known to Europeans. This narrative, "The Land of the White Elephant; Sights and Scenes in South Eastern Asia," is by Mr. Frank Vincent. After making a steam voyage across the Indian seas from Madras, Mr. Vincent landed at Rangoon, once belonging to the kings of Pegu, then to the kings of Ava, but now forming part of British Burmah. Before proceeding up the

magnificent river Irrawaddy, to Mandalay, the present capital of Ava, he visited the chief points of interest at Rangoon. Among others was the Shoah Dagon, or Golden Pagoda, one of the most famous Buddhist temples in the East; and here he found the bell. "What is justly termed the Great Bell of Rangoon is hung in a gaily ornamented pavilion near the large pagoda. I stood upright under it with perfect ease, and a dozen men might have stood there with me. The bell has a long inscription in Burman character, eulogistic of the king who presented, cut around its circumference. Hopes are expressed that for this meritorious gift, replete with the virtue of beneficence, he (the king who presented the bell) may be conducted to Nieban (the Buddhist heaven), and obtain the destined blessing of man," with a lengthened addition of flattering phrases which need not be transcribed here. Proceeding up the Irrawaddy, to Mandalay, Mr. Vincent was shown on the bank of the river, near the suburbs of the city, "a very large bell, the largest in the world with the exception of that at Moscow. It is 12 ft. high, and more than 16 ft. in diameter at the tip; and could easily contain twenty people. There is no clapper, as in former times it was beaten from without. It emits no sound now. It is still slung from a great beam by a huge copper hook or sling; but the hook has given way, and the bell now rests upon some blocks of wood carved in strange grotesque figures. The thickness of the metal of the bell varies from 6 in. to 12; and its actual weight is about *ninety tons*. The exterior measurements of this bell do not much exceed those of the great bell of Pekin; that being 13 ft. in diameter, and 14 ft. in height, but weighing only 53½ tons, being much thinner than the Burman bell."

THE PRACTICAL NOTE-BOOK OF TECHNICAL INFORMATION USEFUL TO STUDENTS AND WORKMEN.

(72.)

NEW Method of Delineating Architectural Objects in Perspective.—In continuation of this subject, we give in fig. 364 an elevation of a small house, and in fig. 365, perspective elevation of the same according to the system described in previous "Notes." To draw the oblique view, as shown in fig. 365, first set up the line of heights, or approaching angle with string courses, cornices, &c.,

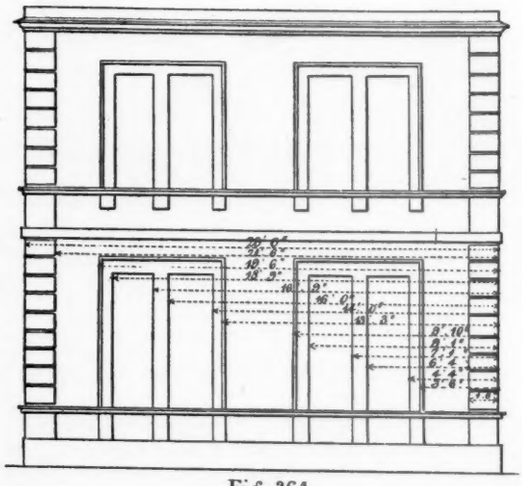
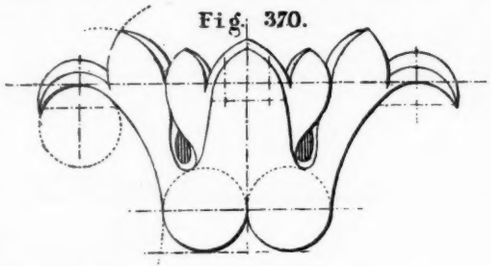


Fig. 364.
Scale ½"=1 Foot

in exact height of elevation, and draw the line of sight about 5 ft. 6 in. above ground line, which will be about the line of vision above ground, and place pins in the drawing board at the vanishing points or line of sight at 1 ft. 9 in. right and left of line of heights. Measure off from perspective scale all dimensions as figured in the elevations in fig. 364, which will give the position of vertical lines; draw the horizontal lines by a straight edge to the vanishing points, and the vertical lines by a T square. Fig. 366 is a plan of a house with a more broken outline of detail than those already given in order to show accidental points, fig. 367 being the elevation of the same.

(73.) **The Elements of Cabinet-making Design.**—In fig. 368 we give in *a* end elevation of a design for foot-board

Fig. 370.



of a bed; in B, front view; and in C section of part *a* in A. In fig. 369 we give details half size. In A, part elevation of pillar; in B, section of ditto, at line *a b*; in C, section through the line

Fig. 371.

a b in fig. 368; in D, ditto through the line *c d* ditto; in E, section through the line *e f* in fig. 368; and in F, section through the line *f g h* in fig. 368. In fig. 370 we give an ornament as

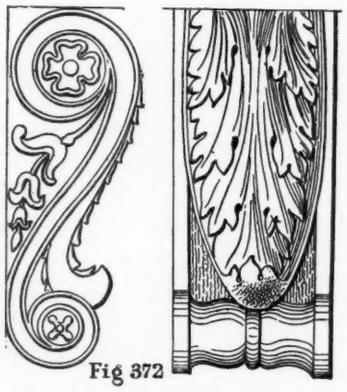


Fig 372

a terminal, with working lines and centres shown. In fig. 371 we give a design for the base of a central pillar for work-table. In fig. 372, design for a console, or bracket. To describe the scroll in fig. 373, describe the arcs *a b*, *b c*, by the method as described in fig. 130, p. 382, Note No. 35, Join the points *a c*;

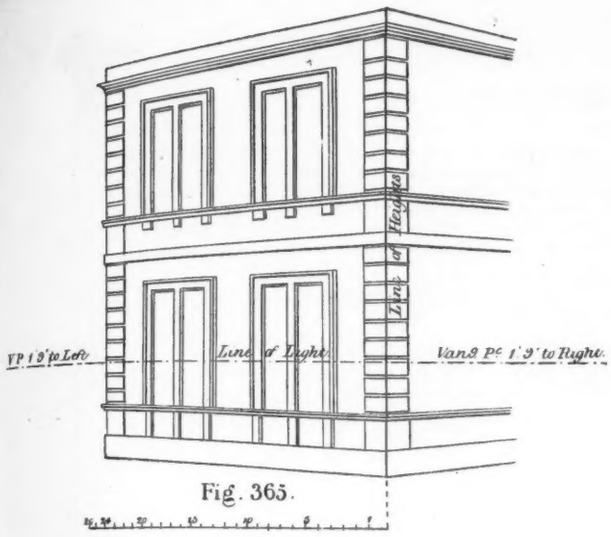
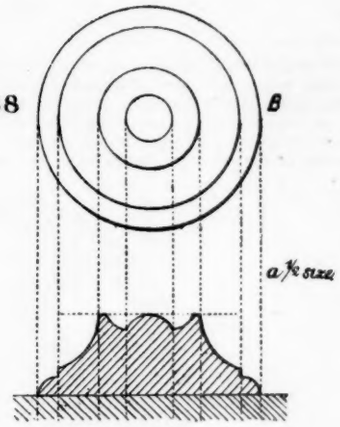


Fig. 365.

Fig 368



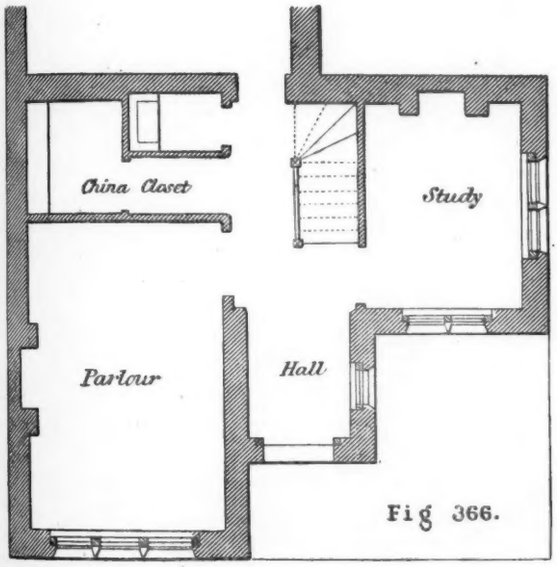


Fig 366.

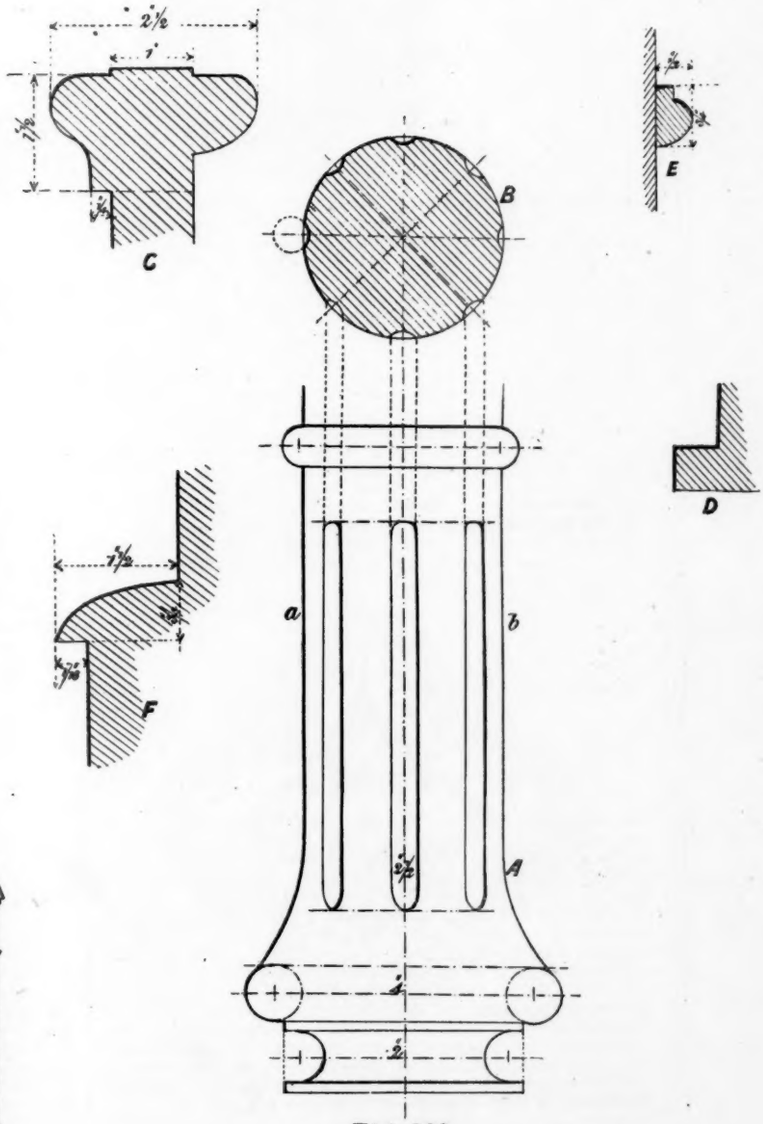


Fig 369.

Fig. 367.

and from the point *b* draw a line *b f* perpendicular to *a c;* from the point where the line *b f* intersects the line *a c*, draw to the angles of the square (found as described in fig. 130, p. 384, Note No. 35, and fig. 54, p. 127) diagonal lines as 1 3 *g h*, 2 4 *i*. Draw the line 2 *j* at right angles to the line *b f*, cutting the diagonal in the point 3. Produce the line *a* 1 to cut the diagonal line *h i* in the point *k*. Set off from *a* to *n*, and from point *m* with *m n* and *m a* describe the arcs of the central step *n o*, *a h*. From point 3, with radius 3 *j*, describe the arc *j f*. From point 4 on the diagonal line *h i*, with radius 4 *f*, describe the arc *f g*. From the centre 5 on the diagonal line *j g*, with radius 5 *q*, describe the arc *q r*. From the centre 6 on the radial line *h i*,

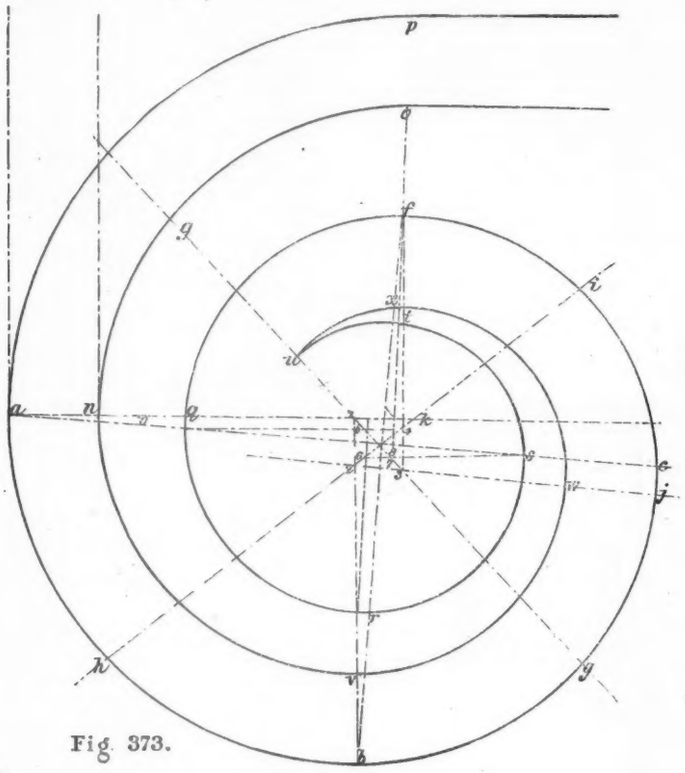


Fig. 373.

with the distance 6 *r*, describe the arc *r s*. From the centre 7 on the diagonal line *g g*, with 7 *s* as radius, describe the arc *s t;* and from centre 8 on line *h i*, describe the arc *t w* with radius 8 *t*. The arcs *n v*, *v w*, *w x*, and *x u*, are described from the

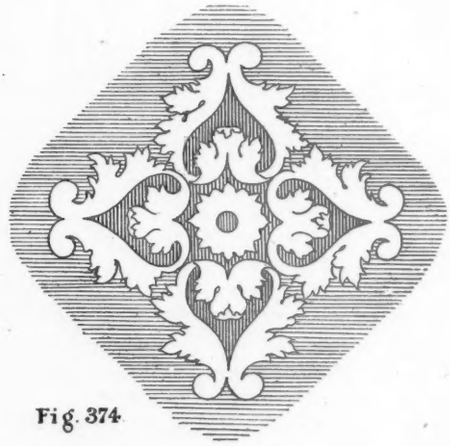


Fig. 374.

centres 1, 2, 3, and 4. In figs. 374, 375, and 376, we give suggestive designs for inlaid scroll work.

(74.) **Elementary Lessons in Projection as applied to the preparation of Constructive Drawings.**—The delineation of an object of surface only, that is having merely length and breadth, is a matter of comparative ease, although under this department there are problems of considerable difficulty, such as the describing of the various forms or surfaces known as geometrical, as the octagon, and the curves, as the cycloid, &c. &c. But length and breadth being the only features of the object, no matter how varied may be the nature of the boundary lines, its dimensions can be at once ascertained from one drawing. But

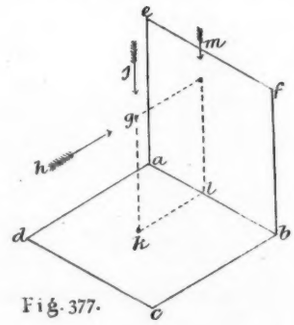


Fig. 377.

with an object having the three dimensions of a solid body—length, breadth, and thickness—the extent or value, so to say, of these dimensions, cannot be ascertained from one drawing only. By certain methods of delineation no doubt this is attempted, as has been stated in the introductory remarks in our "note" on Isometrical Drawing; but the objections to these were there glanced at, and these are so grave in a practical sense that they are not used for practical purposes, but another system is adopted, that being technically known as "orthographic projection," or more simply as "projection." Projection has

for its object the delineation upon a flat surface, as a sheet of paper, the different views of a solid body, and in such a way that the dimensions may be easily "read off" from them by means of an ordinary scale of equal parts. The different views have different names, and what these are, and how obtained we now proceed to show. The surface of the

Fig. 375.

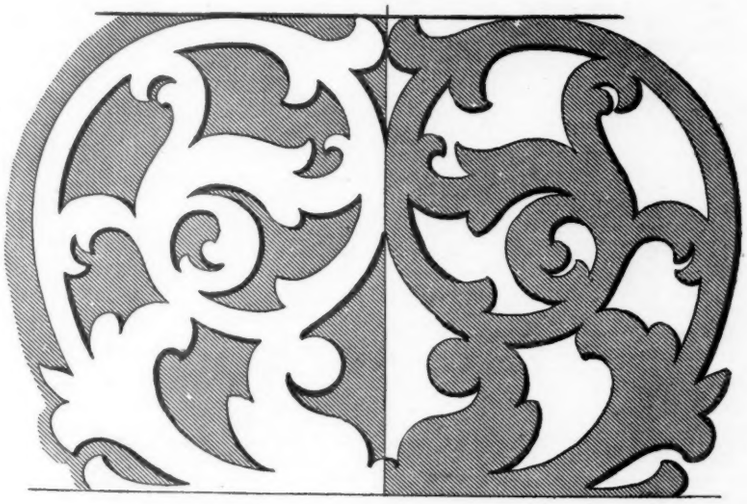
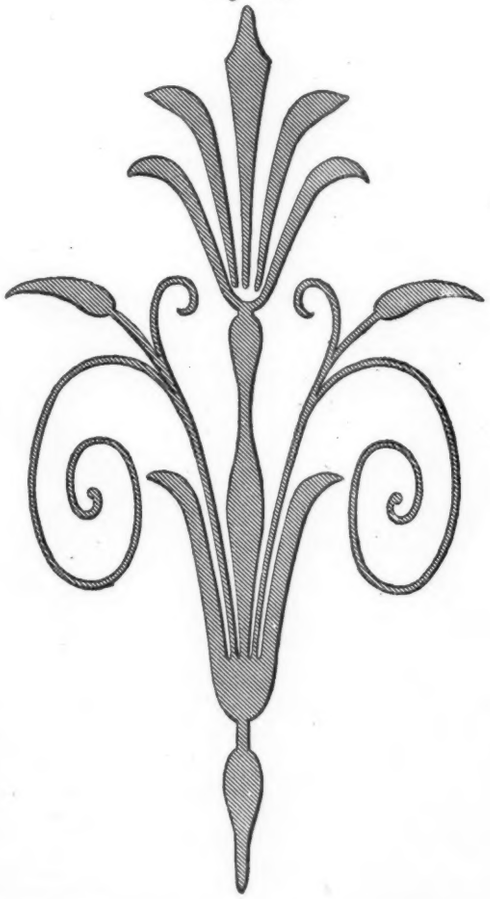


Fig. 376.



sheet of paper on which the drawing is to be generally made is known as the "plane of projection;" and the different points of the drawing are, so to say, "projected" upon this plane, and being united by lines, give one graphic illustration of the various parts required. But strictly speaking, and in accordance with the principles of projection, there are two planes of projection —these being at right angles to each other, so that the one is horizontal and the other vertical, the line at which these intersect each other being called the "ground line." On the horizontal plane, plans are projected, and on the vertical, elevations. In fig. 377, the horizontal plane of projection is *a b c d*, *a e f b* the vertical, *a b* the ground line. Let us suppose the spectator to be looking at the vertical plane of projection *a e f b*, in the direction of the arrow *h*, and that a point is supposed to be at *g*, and further that it is sent forward, so to say, till it strikes the plane of projection *a e f b* at the point *i*, that point (*i*) is the projection of the point *g* in the vertical plane of projection *a e f b*. Suppose again that the spectator is looking down upon the horizontal plane of projection *a b c d* in the direction

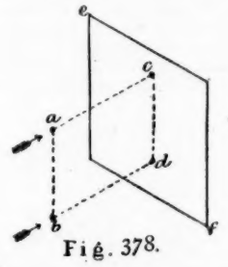


Fig. 378.

of the arrow *j*, and that the point *g* is projected downwards till it strikes or cuts the face of the horizontal plane *a b c d* in the point *k*, then the point *k* is a projection of the point *g* in the horizontal plane. The lines *g i*, *g k*, may be called visual rays, those proceeding in directions at right angles to the vertical and horizontal planes of projection. As a right or straight line is made of points, by projecting the two points which terminate a line, and joining the projection of these points by a line, the projection of that line will be obtained, as in fig. 378, where the points *a* and *b* are projected in the direction of the arrows, to the vertical plane of projection *e f*, at the points *c d;* by joining *c* and *d*, the projection of the line of which *a b* are the terminating points, is obtained in the vertical plane *e f*. A line can in like manner be projected upon the horizontal plane, as shown at *k l*, in fig. 377, the points *k l* being the projection of the points *g* and *i* in the direction of the arrows *j* and *m*. A superficies is a surface having length and breadth only, and is bounded by lines, straight or curved, as the case may be. We can suppose the case of a rectangle, as *a b c d*, fig. 379, this being bounded by lines the terminations of which are the points *a b c d*. By

supposing these to be projected in the direction of the arrow to a horizontal plane of projection, we obtain the points *e f g* and *h;* join these by right lines, and we obtain the projection on the horizontal plane. This may be supposed to be the outline of the top of a box, and being on the horizontal plane, it is therefore a "plan," and may be called the "plan of top," or "plan of bottom," as the case may be. In like manner we may project the four points *i j k l* in the direction of the arrow, so as to strike or cut a *vertical* plane of projection, thus obtaining

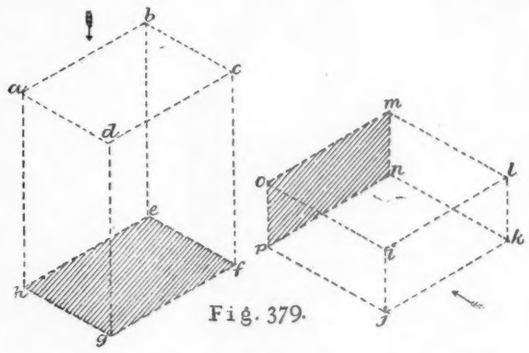


Fig. 379.

the projection of the points *m n p o;* joining these by right lines we have a rectangle, which, being on a vertical plane, is therefore an "elevation," and *o p n m* may be supposed to be the "side elevation," of the box, of which *e f g h* is the top. In like manner we can project four points *a b c d*, fig. 380, in the direction of the arrow; obtaining the projection of these, as *e f g h*, and

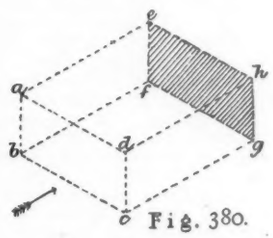


Fig. 380.

joining these by right lines, we obtain a rectangle, which, being on a vertical plane of projection, is also an elevation, and may be the "end elevation" of the box, of which *e f g h*, fig. 379, is the "plan of top," and *m n k l*, fig. 379, is "side elevation." Here we thus have the three "projections" of the solid object, having length, breadth, and thickness, and which, in this case, we suppose to be a box. In working drawings another view is required frequently, namely, a "section," the object of which is to show the internal construction of the solid body, and, according to the direction in which the section is supposed to be made, it is called a "transverse section" or a "longitudinal section." Sections are also either vertical or horizontal; illustrations of these we shall explain as we proceed. In the practice of projection we have, of course, only one flat surface—the sheet of paper—to draw upon; hence, as at the beginning of the note, we remark that it is usually called the plane of projection, although strictly speaking it is the union of the two planes in one, all "plans" being supposed to be projected on to "horizontal planes," and all "elevations" on to "vertical planes." The union of the two planes in one is illustrated in fig. 381, which is simply the diagram in fig. 202 spread out, the vertical plane, *a e f b*, being supposed to be turned down till it lies flat, as at *a e f b* in fig. 381, *a b c d* being the horizontal plane in fig. 377. The line *k l* is a line in "plan," the line *l i* a line in "elevation," corresponding to the same lines in fig. 377. In like manner the separate projections in figs. 379 and

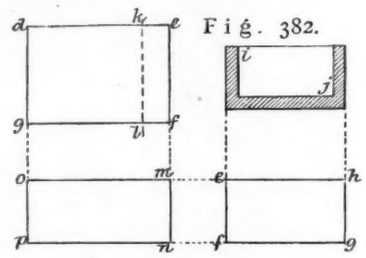


Fig. 382.

380 are shown on one surface or plane in fig. 382. The letters show the corresponding parts. An additional view is given at *i j* in fig. 382, this being a "transverse vertical section" on the line *k l*, and shows the thickness of the sides and bottom of the box. In a simple way the diagram in fig. 382 shows the relations the different views have to one another; and how, having drawn one view on the "plan," as *e f g h k l*, the dimensions, or some of them of another view, may be obtained by producing lines as the dotted ones, which give the length of the side elevation, *o p n m;* from this again the height, *e f*, of the "end elevation" is in like manner obtainable, and from this again the width of the section. But this will be further illustrated in a succeeding note.

(75.) **Method of Delineating Angular-Threaded Screws.**—Having, in Note No. 37, p. 384, illustrated the method of delineating a square-threaded screw, we now give, in fig. 383, that adapted to an angular-threaded one. The principle of operation is the same in both cases, as will be seen as we proceed. Let *a b* be the diameter external of the

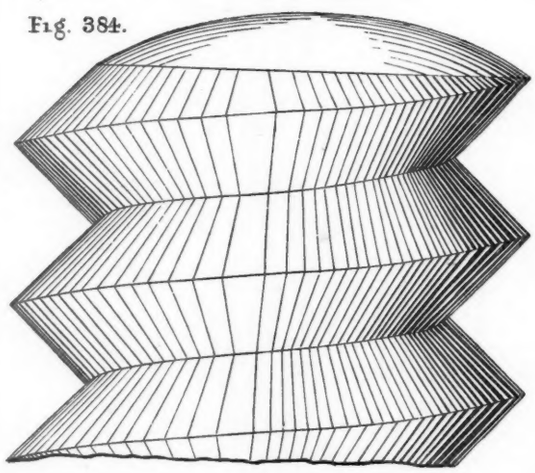
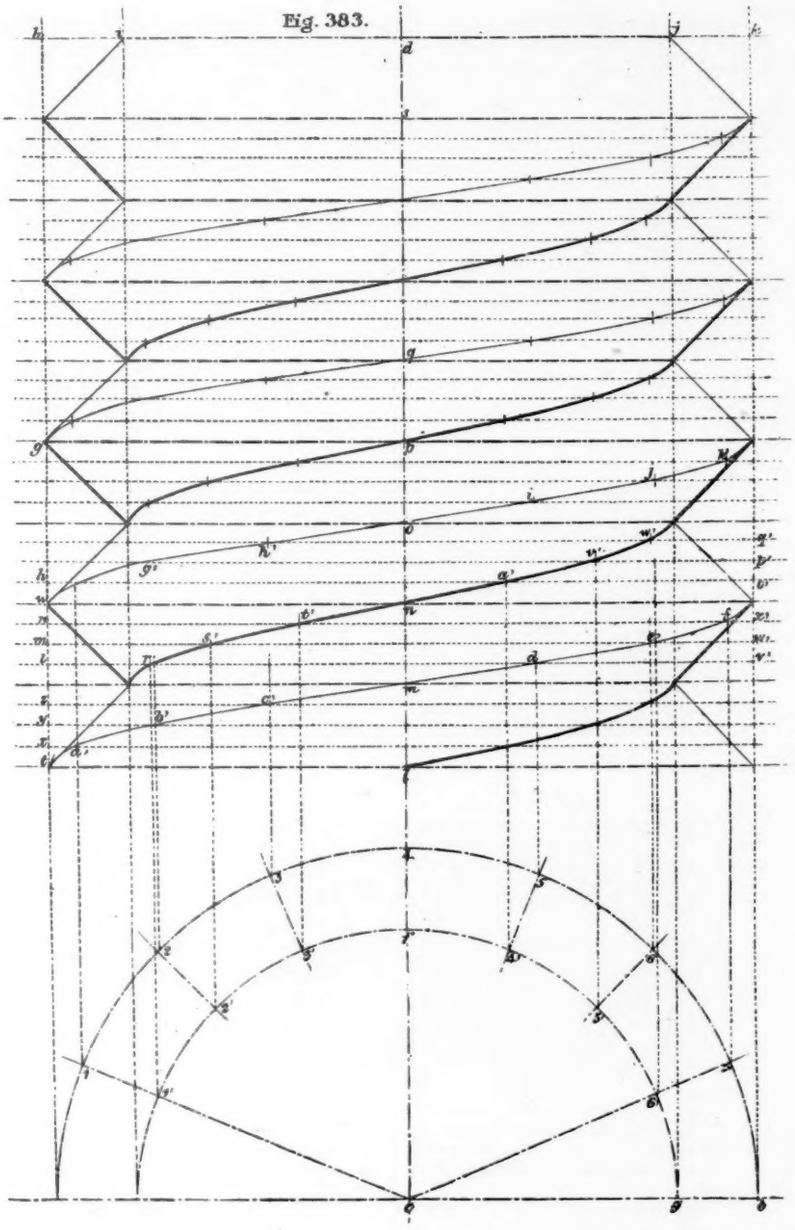


Fig. 384.

screw. Through *c* draw at right angles to *a b* the line *c d*, and from *c* describe the circle *e f g* equal to the internal diameter of the screw. From *a b*, *e* and *g*, draw lines parallel to *c d*, as *a h*, *e i*, *g j*, *b k*. With distance *a e*, or *g b* set off on *c d*, from any point as *l* to *m n o p*, &c., and through these draw lines parallel to *a b*. Divide the semi-circle *a b* into any number of equal parts, as eight in the diagram, as in the points 1, 2, 3, 4, 5, 6 and 7, and through these draw radial lines as 1 *c*, 7 *c*, dividing the interior circle *e f g* into the same number of equal parts. Next divide the distances as *t u* into eight equal parts, or *l m*, *m n*, each into four parts, —the distances, *t u*, or *l n* is the pitch of the screw, the line *m* indicating the central point of the bottom of each thread. Then through the points in *t u* or *l m* draw lines parallel to *a b*. Next from the point 1 on the semicircle *a* 4 *b* draw a line parallel to *c d*, or intersecting the line drawn through *x* in

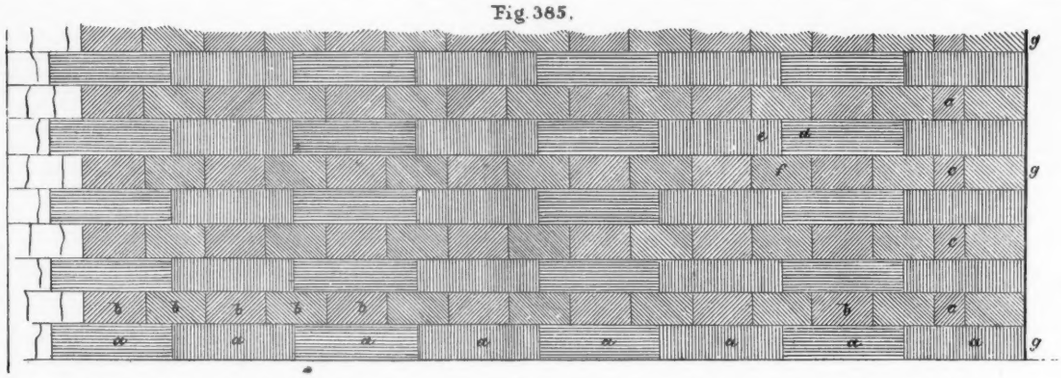
Fig. 383.



the point d'; next from point 2 on semi-circle $a\ b$ draw, parallel to $c\ d$, a line cutting that drawn from y in the point b', next from point 3 draw a line cutting that drawn from z in point c'; from point 5 a line cutting that drawn from points v and d'; from point 6 a line cutting w' in point e, and from point 7 a line cutting that drawn from point x' in f'. By doing the same operations from points in semicircle $a\ b$, cutting the lines drawn through the points between n and o, and g and p, a series of points, as $g'\ h'\ i$, $c\ j\ k$, will be obtained, and by drawing curves through these points and through $a'\ b'\ c'\ d'\ e'$ and f', the upper and lower edges of the screw will be obtained. To obtain the line of the bottom of the screw, or third part passing through the point n. From the points 1′, 2′, 3′, 4′, 5′, 6′ on the semi-circle $e\ f\ g$, draw lines parallel to $c\ d$, cutting the lines passing through the points $l'\ m'\ n'\ o'\ p'\ q'$. The points of intersection of these will give a series of points as $r'\ s'\ t'\ u'\ v'$ and w', through which the curve of bottom line of same will be obtained. Not to complicate the lines in fig. 383, we give in fig. 384 a shaded example of a triangular-threaded screw.

(76.) **The Student's Sketch-Book of Working Drawings.**—Section B, Architecture and Building.—Old English Bond and Brickwork.—The disposition of the separate bricks which make up a wall is effected in peculiar methods, to which the technical term of "bond" is given. The object of bond, as indeed the term implies, is so to place the bricks with relation to each other that they will bind with one another, so to say, so as to form one solid as much as possible. This is effected in more than one way, the two principal methods being known as "old English" and "Flemish bond." In fig. 385, we illustrate the front elevation of a wall built in the first of these, namely, "old English bond," or, as it is more commonly called, "English bond." Bricks which are so placed in a wall that their length coincides with the length of the wall, that is, running parallel in a line supposed to be stretched from end to end of it, are termed "stretchers," that is, the length of the bricks run the long way of the wall, as *a a a a* in fig. 385. Those bricks which run at right angles in the length of the wall, or in other words, lie across it in the direction of its breadth or thickness, are

Fig. 385.



called "headers," as *b b b* in fig. 385. In proper bond no two joints of succeeding courses—each layer of bricks is called a "course"—should coincide with each other; but the joint of two contiguous bricks, such as *e d*, should be placed as near as possible above the central point of the solid part of the brick below, as *f*, this is technically called "breaking-joint." As bricks

Fig. 386.

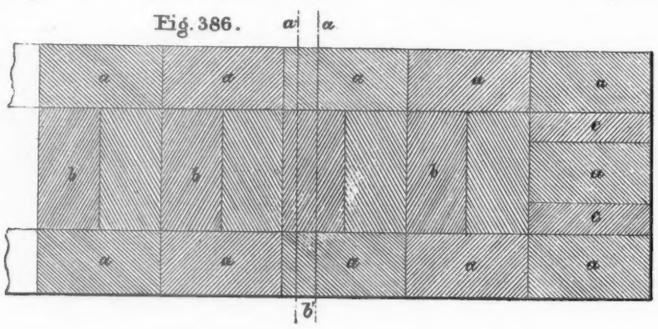
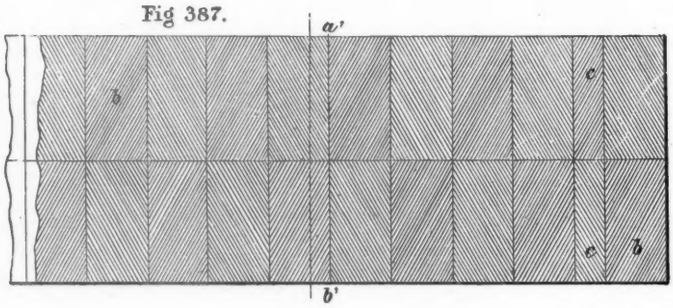
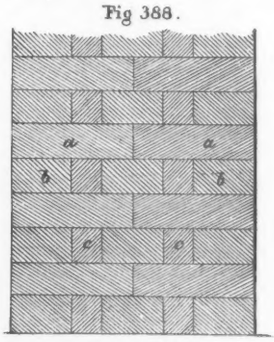


Fig 387.



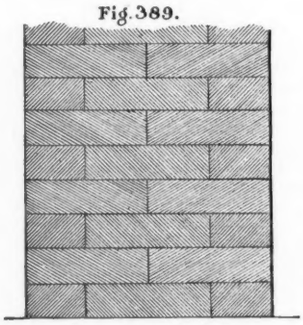
are made of uniform sizes this "breaking-joint" cannot be effected at the termination of a wall, as at *g g*. To secure this breaking of joints at this part of a wall, parts of brick have to be

Fig 388.



used, as *c c c*; these are termed "closers," and are usually formed by cutting a brick in two in the direction of the length of the brick, as at *c c c* in fig. 386. Closers are generally the last brick but one in each course, as shown in fig. 385, but their disposition is changed in each course. Thus, in fig. 386 the closers *c c* are shown to be placed as "stretchers," that is, in a line with the length of the wall in the next course above illustrated; in fig. 387

Fig. 389.



they are shown to be placed as "headers," that is at right angles to the length of the wall. Fig. 388 is an elevation of end *g g* (fig. 385) of wall, and fig. 389, cross section on line *a' b'* in figs. 386 and 387.

Chemistry applied to the Arts, Metallurgy, Chemical Manufactures, and Allied Subjects.

ABSTRACTS FROM FOREIGN PERIODICALS, TRANSACTIONS OF CHEMICAL SOCIETIES, &c.

§ 1. *Acids, Alkalies, and Salts.*

MANUFACTURE of Oxalic Acid from Wood Shavings, Sawdust, Bran, Lignin, &c.—W. THORN states that it has long been known that sodic hydrate can only imperfectly replace potassic hydrate for this purpose; PORSOZ, however, has shown that by the use of 4 parts of soda to one of wood, heated only to 150° to 180°, considerable amounts of oxalic acid are formed.

By heating together large quantities of the following mixture to 200°,—

Sawdust	1 part
Soda	2 „

the yield of oxalic acid is found to attain to 36 parts per 100 of sawdust; at 240° the yield is 33·2 per 100. When a thin layer only of the mixture is employed, 34·7 parts per 100 are obtained at 200°, and 41·6 parts at 220°. When the mixture contains—

Sawdust	1 part
Soda	4 „

the yield is 42·3 with large quantities, and 52·14 per 100 with thin layers.

The molten mass is at first brown, then yellow; above 180° it becomes green, and then emits disagreeable odours. At 200° the operation is difficult to carry out, as the temperature is apt to rise too high spontaneously.

When mixtures of potash and soda are employed, the yield is less than when soda alone is used. Thus the author gives the following tables:—

A.—*Results in large masses.*

Ratio of potash to soda.	Temperature.	Yield of oxalic acid.
	Degrees.	
20 : 80	240	30·04
30 : 70	240	38·80
40 : 60	240 — 245	43·70
60 : 40	240 — 245	42·67
80 : 20	240	61·32
90 : 100	240	64·24
100 : 0	240 — 245	65·51

B.—*Results with thin layers.*

Ratio of potash to soda.	Temperature.	Yield of oxalic acid.
	Degrees.	
0 : 100	200 — 220	33·14
10 : 90	230	58·36
20 : 80	240 — 250	74·76
30 : 70	240 — 250	76·77
40 : 60	240 — 250	80·85
60 : 40	240 — 250	80·08
80 : 20	245	81·21
100 : 0	240 — 250	81·23

Hence a mixture of 40 parts potash and 60 of soda acts as energetically as potash alone.

The yield does not appear to be sensibly increased by the action of air heated to 100°—120° upon the mass at 200°, nor is any better result obtained by the addition of manganese dioxide.

Light woods, such as poplar and ash, give better results than heavy ones, such as oak. Whilst the former give 80 to 80·5 per cent. of acid, the latter only yield about 75 per cent.

The following table indicates the result of experiments on the relative quantities of sawdust and alkali:—

A.—*Results obtained with large masses.*

Quantity of sawdust per 100 of potash.	Acid produced per 100 of wood.	Acid produced per 100 of potash.
50	65·50	32·75
60	54·56	32·73
80	47·12	37·70
100	36·15	36·15

B.—*Results with thin layers.*

Quantity of sawdust per 100 of potash.	Acid formed per 100 of wood.	Acid formed per 100 of potash.
50	81·0	40·49
60	76·30	45·78
80	66·77	53·41
100	54·14	54·14

Hence with thin layers the best yield is that given by a mixture of about equal quantities of sawdust and potash, and this proportion is also best in reference to the price of potash; nevertheless, as the extraction of the acid formed is then more difficult, the relation of 1 part wood to 2 of potash is practically the best.

The oxalic acid may be extracted from the crude mass either by the action of milk of lime, or by the separation of oxalate of soda as a crystalline mass (in cases where mixtures containing soda have been used). The latter is preferable, as otherwise much carbonate of lime is formed, whilst necessitates the use of a larger quantity of sulphuric acid to decompose the lime salts. For this purpose the mass is lixiviated, and the leys concentrated to 38° B. (sp. gr. 1·5); the best crystallization is in this case obtained when 4 parts of mixed alkalies have been used for 1 part of sawdust. The crystalline mass deposited on standing is separated from the highly coloured mother liquor as completely as possible by pressure or by a hydro-extractor, and slightly washed with water; it is then dissolved in boiling water, and a slight excess of milk of lime added, and the whole boiled for two hours; three equivalents of sulphuric acid are necessary to decompose one of oxalate of lime thus produced, the liquor being much diluted with water and boiled two hours. The filtered liquor is concentrated to 15° B., and allowed to stand a few hours, in order that the sulphate of lime may separate completely; it is then concentrated to 30° B., and the oxalic acid which forms on cooling purified by several successive crystallizations.

In order to regenerate the alkalies, the liquors may be concentrated and calcined. Organic matters, however, are not wholly removed by this treatment; it is preferable to add to the liquors as much sawdust as will absorb them completely when concentrated to 40° B., and then to calcine the whole on iron plates in a reverberatory furnace until a sample gives a nearly colourless solution on treatment with water. The product is then exhausted with the weak leys produced during the decomposition of the oxalate of soda by lime; the resulting liquors are concentrated to 42° B., and used over again.

Bran gives better results than sawdust, as the oxalic acid formed is much more easy to purify, and is less coloured. The yield, however, is no greater, whilst the price of bran is higher than that of sawdust. The yield varies with the temperature; below 180° bran gives more oxalic acid than sawdust, but above that temperature there is little difference between the two.

Oxalic acid can be made from the lignose formed by Payen's process for the production of paper pulp from wood, viz., treatment with dilute boiling hydrochloric acid; the incrusting matter is thus converted into glucose, whilst the lignose is unaltered. The best result is obtained by the use of acid of 1·048 sp. gr. (6·5° B.) 800 cubic centimetres of this acid (equivalent to 76 grammes of anhydrous hydrochloric acid) being used to 180 of sawdust; 62·2 parts of lignin are thus obtained, and 20·8 of glucose per 100 parts of wood, or 48·9 per 100 of acid. The acid liquor is neutralized with lime and fermented; on distillation alcohol is obtained of good quality and free from all unpleasant taste; 26·5 litres of alcohol are thus obtained from 450 kilogs. of wood.

Lignose yields less oxalic acid on treatment with soda than does sawdust. *Bulletin Soc. Chim. Paris, xxi. 92, from Dingler's Polytech. Journal, ccx.* 24.

New Process for the Production of Soda and Potash from their respective Haloid Salts by the direct Wet Method.—C. D. ABEL patents the following process:—The salt is introduced together with a solution of

mono-carbonate of ammonia in alcohol into a closed vessel lined with lead which is heated, whereupon the compound is transformed into alkaline carbonate and chloride of ammonium, of which the former is precipitated while the latter is retained in solution. The solution is then drawn off and the alkaline carbonate is washed with spirit and dried. For manufacturing on a large scale the salt is placed in a vessel with perforated double bottom, and a heated solution of carbonate of ammonia in alcohol is then forced through the salt until no more chloride of ammonium is found in the solution.

Extraction of Potash, &c., from Suint.—DANDENART and VERBERT patent the following processes for the extraction of potash as carbonate, that is in its most valuable form, by the most simple and expeditious means, and for the extraction of the fatty matters.

The wool washwaters are heated to about 80° and mixed with a solution of baryta or strontia in the waters previously used at about 60°, more or less baryta being used according to the strength of the liquors; after keeping up the temperature for about an hour and agitating from time to time, the whole is allowed to rest. A precipitate quickly separates, so that the supernatant liquid is perfectly clear when the operation is properly performed. This is then decanted off, evaporated down, and calcined. To purify the potash salt, it is refined in the same way as the potashes of commerce.

The precipitate is treated with hydrochloric acid (after being pressed to extract all the alkaline liquors). The liquor should have a density of 4° to 5° B. The fatty matters that separate are cold pressed and then hot pressed, and purified in the usual ways.

The chlorides of barium and strontium are again converted into caustic baryta and strontia and used over again. *Bulletin Soc. Chim. Paris, xxi.* 143.

In another patent the same authors describe the following methods for the preparation of baryta and strontia compounds:—

The chlorides are converted into carbonates by means of carbonate of magnesia and superheated steam in specially constructed apparatus. The resulting carbonates are then caustic ized by the action of heat, or by superheated steam when previously mixed with charcoal. The sulphates may be similarly converted into caustic bases. *Ibid.* 144.

Cinchona Barks.—E. DE VRIJ gives the following percentage of quinine in various barks:—

Bark.	Pure Quinine.	Crystallized Sulphate.
Cinchona succirubra (Cold Spring)	1·958	2·50
C. calesaya	1·265	1·612
C. palindiana	0·964	1·229
C. officinalis	0·46	0·586
C. succirubra	0·463	0·59
C. micrantha	?	—

Pharm. J. Trans. [3] *iv.* 121.

DE VRIJ also gives the following numbers for various specimens of bark (dried at 100°) of cinchona officinalis:—

Barks.	Total Alkaloids.	Quinine.	Crystallized Sulphate.
Variety angustifolia	10·130	8·000	10·199
" "	10·960	9·100	11·600
C. officinalis: seedling grown at elevation of 6,200 ft.	6·050	2·286	2·914
" "	10·670	3·707	4·725
C. officinalis: renewed bark 18 months old	4·630	2·470	3·136
C. officinalis: renewed bark 15 months old	8·140	4·530	5·775
C. officinalis: renewed bark 28 months old	10·000	2·917	3·718
C. officinalis: branch bark	3·115	1·760	2·243
" small "	0·984	—	—
" stem bark: mossy	7·285	4·781	6·095
C. officinalis: stem bark: not mossy	4·785	2·600	3·314
C. officinalis: large leaved seedling, elevation 8,200 ft.	2·860	Nil.	—
C. officinalis: exposed situation, elevation 8,400 ft.	8·920	2·345	2·989
C. officinalis: sheltered	8·424	5·340	6·807
" exposed situation, elevation 5,800 ft.	5·726	1·410	1·797
C. officinalis: manured	11·660	6·950	8·860
" not manured	8·366	3·750	4·780

Ibid. p. 181.

JOBST finds that *cinchona calisaya* is often very rich in quinine—two samples giving respectively:—

Quinine sulphate	3·20 per cent.
" "	7·62 "

Other samples, however, were less rich, whilst *C. narskarliana* also contained but little, and *C. caloptua* gave only 0·99 per cent. of quinine sulphate. *Berichte der Deut. Chem. Ges. vi.* 1,129.

Extraction of Sulphur and preparation of Sulphite, Bisulphite, and Hyposulphite of Calcium from natural or artificial Sulphate of Lime.—MARTEN patents the following processes:—

1. Extraction of sulphur and preparation of sulphite, bisulphite, and hyposulphite of calcium, and other sulphur compounds, from the products of decomposition of natural or artificial sulphate of lime, dry or hydrated.

2. Use of oxygen in the nascent state to oxidize sulphides, oxysulphides, and polysulphides of calcium, and to transform them into sulphites, bisulphites, &c.

3. Use of metallic chlorides (*e.g.*, manganese chloride), which have the power of forming by double decomposition insoluble sulphides, when brought into contact with soluble sulphides, polysulphides, sulphites of oxysulphides, &c., of calcium. *Bulletin Soc. Chim. Paris, xxi.* 141.

Preparation of Nitrite of Ammonia. — BERTHELOT prepares this salt by the double decomposition of pure nitrite of barium by the equivalent quantity of sulphate of ammonia; the solution thus obtained is evaporated in vacuo over quicklime; the yield is only 30—40 per cent. of the theoretical amount, owing to the spontaneous decomposition of the salt into nitrogen and water. Even in winter the solid salt decomposes slowly, in summer the change is rapid; when heated to 60°—70° it detonates with violence; when struck with a hammer the same result occurs. The salt forms a white crystalline elastic mass, very deliquescent and much resembling artificial camphor. *Bulletin Soc. Chim. Paris, xx.* 55.

Preparation of Chloride of Aluminium.—P. CURIE finds that the vapour of carbon disulphide, when transmitted over red-hot alumina, forms a sulphide of the metal, which is readily decomposed by hydrochloric acid gas with the formation of aluminium chloride. To prepare this salt, alumina is heated in a porcelain tube in a furnace; as soon as all moisture is expelled a current of mixed hydrochloric acid and carbon disulphide vapours is passed through the tube; this mixture is conveniently obtained by bubbling the hydrochloric acid gas through liquid carbon disulphide. The alumina chloride produced distils over, whilst calcium and other chlorides, if produced, are left behind in the tube. Ordinary clay may be used, chloride of silicon being formed, but being carried away with the escaping gases without condensing. *Chemical News, xxviii.* 307.

Chloride of Molybdenum.—LIECHTI and KEMPE describe several chlorides of this metal, viz., a pentachloride, a tetrachloride, a trichloride, and a dichloride, denoted respectively by the formulæ $Mo Cl_5$, $Mo Cl_4$, $Mo Cl_3$, and $Mo Cl_2$. *Berichte der Deut. Chem. Ges. vi.* 991.

Manufacture of Chloral Hydrate.—G. DETSENYI states that this substance is now prepared in large quantities, some factories turning out 250 kilogs. per diem, the value being 11¼ francs per kilog.; the chief point to notice in the manufacture is to use alcohol of not less than 96 per cent.; chlorine is passed through 60—75 kilogs. of this alcohol for from twelve to fifteen days, the liquor being finally heated to 60° to 75°, and acquiring a density of 41° Baumé; the product is then distilled along with its own weight of sulphuric acid; hydrochloric acid gas first comes off, and when this ceases, chloral comes over and is collected; all that passes below 100° is mixed with water, when the crystalline hydrate separates; this is melted and allowed to solidify into cakes in porcelain dishes. *Bulletin Soc. Chim. Paris, xxi.* 91. *From Dingler's Polytech. Journal, ccix.* 224.

§ 2. *Dyeing, Calico Printing, Bleaching, Tanning, and allied subjects.*

Nicholson Blue on Cloth.—For every 100 parts of material 1 part of dyestuff is employed, and ½ part of sulphate of zinc; the goods are worked for an hour in this bath, the heat being gradually raised to boiling. They are then rinsed in cold water, and passed through a bath at 70° R., in which 2 parts sulphuric acid and 1 of sulphate of zinc have been dissolved. *Reimann's Färberzeitung, No. xliv.* 1873.

Nicholson Blue.—A bottom of camwood may be advantageously given to cloth dyed with this substance. For 100 parts of cloth a bath is used made up of :—

Potassium chromate . . .	1 part.
Sulphuric acid	1 „

The goods are boiled in this for an hour and allowed to cool in the vat. They are then rinsed and dyed in a bath made from 30 parts of camwood, and are then passed through a bath of :—

Nicholson blue . . .	2 parts.
Sulphate of zinc . . .	1½ „

In this they are boiled for two hours, and are then rinsed and placed in a bath of :—

Sulphuric acid . . .	8 parts.
Sulphate of zinc . . .	2 „

Reimann's Färberzeitung, No. xliv. 1873.

Aniline Violet for Woollen Goods.—For every 10 lbs. of goods 1 of sulphate of magnesia is used. This is made into a bath, into which the goods are dipped. Methyl violet is then added, in quantity sufficient to give the desired shade, and the whole quickly heated to boiling. *Reimann's Färberzeitung, No. xliv.* 1873.

Recovery of Alizarin.—STENHOUSE and THOM propose to recover the alizarin which passes into the liquors that have served for brightening dyed and printed goods in the following manner :—The liquors are mixed with chloride of calcium solution, and to the mixture a certain quantity of lime is added. The whole is agitated and left for twelve hours to settle. The clear liquid is then drawn off, and the muddy residue treated with hydrochloric acid of about 33 per cent. strength. The solution, which now contains liberated fatty matters and the colouring matter in suspension, is filtered through flannel stretched over flat wooden frames. The filtrate, consisting chiefly of calcic chloride solution, may again be used for treating waste liquors from dye works. The residue left on the filter is gently heated until the fat becomes melted, then allowed to cool, and the cake thus obtained is pressed in bags or treated with a hydrocarbon oil in order to remove the fat. The remaining colouring matter is now boiled with sulphuric acid, washed and filtered ; it is as serviceable for dyeing purposes as newly manufactured alizarin.

Madder Red.—100 parts of goods are boiled for one hour in the following bath :—

Alum	3 parts.
Tin crystals	6 „
Tartar	5 „
Flavin	¼ „

and are then passed into a bath made from 15 parts of madder. Finally they are passed through a vat containing :—

Ground cochineal . . .	4 parts.
Tin crystals	1½ „
Oxalic acid	1 „

and boiled therein for an hour. *Reimann's Färberzeitung, No. xliv.* 1873.

Preparation of Felt from Rabbit and Hares' Fur.—DELPECH states that the ordinary process consists in soaking the fur in an acid solution of mercurious nitrate, whereby the hair becomes altered in structure and somewhat transparent.

HILLAERT proposes to use, instead of the mercury compound, a mixture of treacle, or some analogous substance, and nitric acid. The action on the hair is due to nitrous acid, which can be readily produced in contact with the hair by this means without necessitating the use of the expensive and poisonous mercurial solution. The workmen are by this new process protected against injury ; but, on the other hand, the felted hair is less easily washed when prepared by this new process than it is when the old mercurial process is used. *Dingler's Polytech. Journal, ccix.* 230. *From Journal Pharm. Chim.* [4] *xvii.* 453.

Dyeing Artificial Hair.—When chignons, &c., are dyed of a blonde colour, with fustic and alum, annatto being added when requisite, a carroty tint is apt to be produced, especially when viewed by artificial light. Logwood, with an iron mordant, cudbear, fustic, and tartar being also employed, gives the best result as regards shade. *Reimann's Färberzeitung, No. xliv.* 1873.

Tannin.—SCHIFF concludes from an extended investigation into the nature of tannin, that the natural tannin is a body of the class known as *glucosides, i. e.* it contains the elements of glucose and of a peculiar acid (*tannic acid*) *minus* the elements of water. This tannic acid is really related to gallic acid, being simply the ether or anhydride of gallic acid, *i. e.* gallic acid, *minus* the elements of water. *Annalen der Chem. und Pharm. clxx.* 43.

Red-brown Paint for Wood.—KUHR washes the wood with the following solutions, No. 1 being first applied and then No. 2 :—

No. 1.

Sulphate of copper . . .	1 lb.
Water	4 litres.

No. 2.

Ferrocyanide of potassium .	½ lb.
Water	4 litres.

The wood thus becomes covered with brown ferrocyanide of copper. This is not affected by the weather, and is not liable to the attacks of insects. The painted wood can be varnished with linseed oil varnish if desired. *Dingler's Polytech. Journal, ccix.* 466.

§ 3. *Metallurgy.*

New Process for Iron Making.—F. W. GERHARD has completed a new process which is attracting considerable notice. The invention consists in the manufacture of puddled iron direct from the ore, the use of the blast furnace being dispensed with. Instead of using pig-iron, Gerhard uses a compound which he calls "iron coke," and which consists of a mixture of ore (or any substance containing iron) the necessary fluxes, and its equivalent of carbon. A lump of this compound is put into the furnace, and by the single process known to the puddler as "balling," a "heat" may be obtained in considerably less time and with considerably less labour than under the old method ; the process of "melting" and "boiling" being entirely dispensed with. The most important feature of the invention is the great saving which it effects in fuel. Bell estimates that 5½ tons of coal are required to produce a single ton of bar-iron, but Bennett Aitkins puts the amount at six tons seven hundredweight. Taking the average at six tons it may be reckoned that two tons are consumed in the blast furnace, and the remaining four tons in the finished ironworks. The protoxide of iron containing 77·78 per cent., requires 21·43 of carbon. The magnetic oxide, containing 72·41 per cent., requires 32·17 carbon. Admitting that the three descriptions of iron ores were employed in the making of cast-iron, by the new process, then 30 lb. of carbon would suffice to produce 100 lb. of cast-iron ; or a ton of iron weighing 2,400 lb., would require 750 lb. carbon, a saving of 3,760 lb. carbon as compared with the ordinary method. It is obvious that when heavy pieces of solid pig-iron are placed in a puddling furnace to be melted, the greater portion of heat is wasted, and after it is liquefied a much longer time is required to eliminate the carbon which it contains and other extraneous elements of which it is composed, with a continuation of an immense waste of fuel. On the contrary, when the "iron coke" is thrown into the heated furnace, the carbon which it contains immediately acts upon the oxygen contained in the ore. Even the Barrow hæmatite—one of the most refractory of ores—is ready for "balling" with a much less expenditure of time, labour, and fuel than by the old process. These statements have been abundantly verified by experiments made in the presence of practical ironmasters and ironworkers, who speak very highly of the merits and importance of the invention. *Iron, Dec. 27th,* 1873.

Nickel Ores.—KNOP states that a nickeliferous magnetic pyrites occurs at St. Blasien in the Black Forest. This has the following composition :—

Specific gravity	4·43
Hardness	between 4 and 5
Sulphur	45·87
Iron	41·96
Nickel	11·98
	99·81

Another variety is also found containing somewhat different proportions of the same ingredients :—

Sulphur	40·03
Iron	55·96
Nickel	3·86
	99·85

When exposed to the air, these nickel ores become oxidized, soluble sulphates of nickel and iron being formed. In this way the

nickel may be extracted without causing any damage to the neighbourhood by the fumes of sulphurous acid evolved in the ordinary smelting process. *Jahrbuch für Mineralogie*, 1873, 521.

Nickel Coin.—The German mint has issued five and ten pfennig-pieces containing nickel, some of which are already in circulation in Mecklenburg. FLIGHT has recently found nickel in certain ancient coins. A quantitative analysis of a Bactrian coin of the second century B.C. showed the coin to possess the following percentage composition :—

Copper	77·585
Nickel	20·038
Cobalt	0·544
Iron	1·048
Silver	trace
Tin	0·038
Sulphur	0·090
	99·343

The coin essentially consists, therefore, of an alloy of copper and nickel, the percentage composition of which differs in no considerable degree from that of the alloy of which the five and ten centime pieces at present issued by the Belgian mint are composed. P. DEWILDE analyzed the Belgian alloy a few years since, and found it to possess the following composition :—

Copper	74·4
Nickel	25·55
	99·95

The legal standard of the alloy adopted by the Belgian mint is copper 75, nickel 25. The specific gravity of a ten centime piece was found to be 9·16, a number somewhat in excess of that found in the case of the Bactrian coin, and due, doubtless, to the far greater pressure to which the former coin had been subjected. The fracture of the two coins was very similar.

Nickel was first shown to be a metal by Cronstedt in the year 1751. In Saxony and Bohemia had been found veins of an ore of a reddish tint, bearing a great resemblance to that of copper. Attracted by the colour, the Saxon smelters endeavoured to obtain copper from this ore, but finding all attempts to extract this metal of no avail, they gave the ore the ill-name of Kupfernickel, and cast it aside. Cronstedt afterwards investigated the subject, showed that Kupfernickel contained a new metal, up to that time unknown, and named it after its ore, nickel.

Although this metal was isolated but a little more than a century ago, and has only since Cronstedt's time come into general use in Europe, it seems to have formed a very constant constituent of some of the alloys known for a long time to the Chinese. Fyfe found "Packfong," or "Packtong," to consist of copper 40·4, nickel 31·6, zinc 25·4, and iron 2·6. Tutenag contains copper 45·7, nickel 17·4, and zinc 36·9. Levol, moreover, gives an analysis of a specimen of "white copper" from China, containing copper 79·4, nickel 16·02, and iron 4·58, which, it will be observed, bears a great resemblance to the Bactrian and Belgian alloys.

The alloy of nickel and copper, of which the Bactrian coin is composed may perhaps have been obtained by a method similar to that at present adopted at Kleva, in Sweden. A magnetic pyrites, containing sulphides of copper, nickel, and iron is roasted in heaps, and then mixed with quartz and smelted. The iron oxidized by the roasting passes away with the silicic acid in the form of slag, and a matt of copper and nickel is obtained. This is broken up, roasted in a reverberatory furnace, and then fused again, and after having been subjected to several repetitions of these processes, furnishes matts very rich in nickel, the final matt being an alloy of nickel 70 to 80, copper 18 to 22, and iron 1·5 to 2·5.

[*Note by Abstractor.*—It is an interesting question whence the ancients got their nickel.

Cunningham inclines to the opinion that the nickel employed in the preparation of those ancient coins must have come from China. Certain it is that ancient writers speak of "white iron," which could hardly have been anything else but nickel.

It may also be stated, that a few years ago, Graham, the late Master of the Mint, issued penny and halfpenny pieces, of the same size and similar design to our own, for use in Jamaica, which contained 20 parts of nickel to 80 of copper.

Extraction of Gold from Quartz.—READING proposes the following improved process for the treatment of quartz :—As far as the experiments have gone they have been highly successful. The treatment consists first in strongly heating the quartz, and then whilst red-hot plunging it into a bath prepared with acids. The effect of this is to render the quartz perfectly friable, so much so that it can be readily reduced to powder by the Chilian mill, without the intervention of the ordinary crushing battery. The hard stone is converted into an earthy matter, which is carried off easily by a gentle flow of water through the basin of the mill. The sulphides, too, are all destroyed, and the quicksilver continues bright and lively, taking up every particle of the gold, however fine.

Valuation of Gold and other Alloys by the Spectroscope.—N. LOCKYER and W. C. ROBERTS find that it is practicable to obtain quantitative results by means of the spectroscope. By examining the image of an electric spark passing between a fixed electrode and another electrode made of the unknown alloy, it is possible to detect minute differences in the composition of certain alloys; if it be ultimately found possible to replace the ordinary method of "parting" by a simple spectroscopical observation, a great saving of time in the valuation of bullion will be effected. *Proceedings of the Royal Society*, *xxi.* 508.

Recovery of Silver from Spent Argentic Baths.—GRÄGER finds that silver cyanide is readily reduced to the metallic state by grape sugar, provided that no potassium cyanide is also present; this latter may be eliminated by adding protosulphate of iron, whereby ferro-cyanide of potassium is produced. The sulphate should be added to the hot liquid until a little permanent precipitate is produced, then caustic soda or potash, till the liquid is strongly alkaline; the glucose is then added until the liquor acquires a brown-yellow tint; on cooling almost every trace of silver contained in the bath is deposited in the metallic state; a little oxide of iron is mixed with the precipitate; this is separated by dissolving the silver out by means of nitric acid, which scarcely attacks the iron. Even when copper is intentionally added to the argentic liquid, no trace of that metal is precipitated along with the silver. *Moniteur Quesneville*, *December*, 1873, *p.* 1100. *Dingler's Polytech. Journal*, *ccix.* 200. *Bottger's Polytech. Notizblatt*, 1873, *No.* 14.

Metallurgy of Bismuth.—CARNOT describes the following process for the extraction of bismuth from the hydrocarbonate, an ore found tolerably plentifully (together with others —*vide* "Practical Magazine," February, 1874) at Meymac (Corrèze) :—

The general composition of this mineral is as follows—the hydrocarbonate is formed by the alteration of sulphide; it usually contains small quantities of arsenic, antimony, lead, iron, lime, &c., together with stony and quartzose gangue, or with a matrix consisting of silicates.

To extract the metal, the ore is broken up by hammers into coarse sandy powder, and then treated with hydrochloric acid; the undissolved portion is treated over again in the same way two or three times successively, the acid used in the second treatment being used for the first action on a new batch, and so on continuously; earthenware vessels are used, which may be advantageously warmed from time to time, and stirred up with a wooden spatula. The insoluble residue finally obtained thus is valueless, whilst the acid used is saturated with the dissolved metallic oxides; the filtered liquid is placed in vats, in which rods of iron are immersed. The bismuth is then thrown down in the metallic state as a heavy black powder; the iron liquor is run off before it has time to become peroxidized, and deposit sesquioxide; the deposited bismuth is then washed with water, and pressed and dried quickly to prevent oxidation, which rapidly takes place with the finely divided metal. The dry powder is then rammed into a plumbago crucible with an iron pestle, and the upper part of the crucible filled with fragments of charcoal; the whole is then heated for three-quarters of an hour to a temperature not above redness, otherwise loss occurs from volatilization; the molten bismuth is then run into moulds, and sold in the form of ingots.

If required for medicinal purposes (preparations of the basic nitrate), the ordinary purification processes must be adopted to get rid of traces of lead, arsenic, and antimony.

This process is economical, no appreciable quantity of metal being lost in the form of slag. This is a source of considerable loss in the dry process usually adopted. The product is fairly pure, and hence little cost is requisite for purification; the plant requisite is not costly, and highly skilled hands are not requisite to work it. About 250 kilogrammes (some 5 cwt.) of metallic bismuth have been thus satisfactorily prepared. *Bulletin de la Soc. Chim. Paris*, *xxi.* 114.

Tellurium Ores.—BURKART describes various ores of this rare element occurring in different parts of the United States. Bismuth telluride is found in Virginia and Georgia; silver telluride in Eldorado County, graphic tellurium ore (sylvanite) in the Melones and Stanislaus mines, Caleveras County.

Genth found numerous tellurium ores on the western declivity of the Californian range, and Silliman found others in different parts of California. *Jahrbuch für Mineralogie*, 1873, 476.

§ 4. *Food and Sanitary Matters.*

Purification of Sugar by the Phosphates of Ammonia and Baryta.—P. LAGRANGE employs phosphate of ammonia as a means of eliminating lime from syrups. Ammonia is thereby set free; this soon volatilizes, whereby the liquor is apt to become acid instead of alkaline. In this case baryta, or sucrate of baryta, may be used to decompose alkaline sulphates, whereby an alkaline syrup is maintained throughout.

Usually syrups of 20° B. are those which require this purification, and these have generally undergone a treatment by lime and carbonic acid. The liquors are placed in a jacketed boiler or in one heated by a steam worm; the phosphate of ammonia is then added in quantity proportionate to the lime in solution and then the baryta, until not more than the hundredth of the matters perceptible by the re-agent is left; the whole is then boiled and filtered through Taylor's filter, and finally through animal charcoal.

In refining sugar this process is used instead of the animal black and blood serum process. Phosphate of ammonia is added in proportion to the lime present, so that not more than a hundredth is left; this is absorbed by the animal charcoal subsequently; then the baryta liquor is added in proportion to the sulphates present. After melting, the whole is boiled, the precipitate formed changes the liquid in much the same way as blood albumin. The liquors are filtered through Taylor's filter, and through animal charcoal, and then treated as usual, the subsequent operations being performed with great regularity.

To obtain the maximum yield, 800 grammes of crystallized phosphate of ammonia and 3 of crystallized baryta (containing 10 equivalents of water) are required for 1,000 kilogs. of sugar testing 88°. *Comptes Rendus, lxxvii.* 1245.

Tea.—A. S. WILSON gives the following figures as to the composition of different specimens of tea. Nos. 1 to 8 are all genuine, whilst No. 9 is faced with steatite or other magnesian silicate, turmeric, and prussian blue in small quantity.

Column 1 represents the total percentage of ash; 2 the siliceous matters; and 3 the peroxide of iron therein contained.

	1.	2.	3.
1. Moning	6·00	0·82	0·05
2. „	5·82	0·57	0·07
3. „	5·90	0·78	0·07
4. „	5·55	0·68	0·09
5. Kaisow	5·43	0·22	0·05
6. Foochow Pekoe	6·15	0·79	0·09
7. Assam Souchong	5·15	0·20	0·03
8. Green Assam	5·32	0·27	0·08
9. Fine green tea, faced	7·14	1·57	0·12
10. Black tea, mixed	5·68	0·49	0·04

Chemical News, xxviii. 307.

Valuation of Wood Spirit.—G. KRELL determines the amount of true methylic alcohol in commercial wood spirit by estimating the quantity of methyl iodide produced therefrom by treatment with phosphorus and iodine.

Thirty grammes of phosphorus iodide are placed in a flask holding about 100 cubic centimetres, and the wood spirit to be tested gently dropped in. The whole is slightly warmed, a condenser being affixed, so that any volatilized substances may drop back; after a few minutes the whole is distilled over and collected in a graduated tube. Five cubic centimetres of pure methyl alcohol should yield 7·19 of methyl iodide. *Bulletin de la Soc. Chim. Paris, xxi.* 90. *From Berichte der Deut. Chem. Ges. vi.* 1310.

Nature of Fermentation.—KARSTEN denies that yeast consists of a species of fungus, and regards it as produced by an abnormal development of the cell progeny contained in the tissue cells of plants, when the organisms to which those cells belong are dead or dying. Thus he finds that fruits preserved in carbonic acid and other gases for a considerable time, although maintaining the most perfect freshness of appearance, have really undergone a certain amount of alcoholic fermentation, the cell progeny in the cells of the fruit becoming converted into yeast cells in the presence of juices containing sugar. Decomposition originates in a similar fashion, the mode of development of the cells being "dependent upon the chemical nature of the cell fluid and the matter and forces acting from without." Thus, in albuminous fluids putrefaction occurs, with production of the bodies known as "bacteria" and "vibrios." *The Globe.*

Brazil Chestnuts.—B. CORNWINDER gives the following analysis of the kernel of the Brazil chestnut (*Bertholettia excelsa*) and that of the earthnut (*Arachis hypogæa*) :—

	Brazil Chestnut.	Earthnut.
Water	8·00	6·76
Oil	65·60	51·75
Nitrogenous substance	15·31	21·80
Organic non-nitrogenous matter	7·39	17·66
Phosphoric acid	1·35	0·64
Lime, potash, silica, &c.	2·35	1·39
	100·00	100·00
Nitrogen	2·45	

The oil of the Brazil chestnut soon becomes rancid, but it would probably be valuable for soap-making, whilst the oil-cake thence obtained would be a good manure even if not available for feeding cattle. *Journal de Pharmacie et de Chimie* [4] *xviii.* 14.

Injurious Action of Coal Gas on Vegetation.—SPATH and MEYER publish further results confirming those previously obtained by them, viz., the action of coal-gas on the roots of trees; a given quantity of gas has much less injurious effect in winter than in summer; when 6 cubic feet (0·0185 cubic metre) were passed daily into a plot of 14·2 square metres (153 square feet) in area and 0·785 metres deep (2½ feet) for seven weeks, 6 trees out of 17 grown on the plot were killed. After eleven weeks all were dead, but two or three were sickly. Lime and elder trees appear to be the least affected. *Landw. Versuchs Stationen, xvi.* 336.

New Earth-Closet. R. M. CAFFALL patents a new form of earth-closet which resembles others in having a receptacle for earth, from which falls a measured quantity of earth on each occasion of use. Its characteristic feature is that there is an "earth-spreader," which distributes the earth in the manner best calculated to cover and absorb the excreta. In conjunction with this there are two "radial plates," which serve as a self-acting lid, and prevent dust from flying out during the spreading of the earth, as well as ensure the shutting up of the closet. The seat, with a long oval aperture, is hinged at the back, and in front bears upon two pins which, when the seat is depressed, push down a rocking frame pivoted at the centre so that the back rises and liberates earth from the receptacle behind, at the same time setting in action levers which move the spreader to one side, and open the radial plates. On pressure being removed from the seat, a reverse action occurs. The radial plates revolve on their pivots, and noiselessly close the aperture in the seat, while the earth-spreader is brought back to the centre and receives a charge of dry earth, which, by a few revolutions of the spreader, is favourably distributed over the contents of the pan beneath. The earth-spreader is a circular disc or fan with slits running from the circumference towards the centre, on which it is pivoted at an acute angle from the horizontal, so that the earth may be scattered chiefly around the sides of the pan. A variation of this angle naturally induces a corresponding variation in the position of the earth when scattered. The radial plates are of a peculiar shape, so contrived and pivoted as to clear and close the opening with the smallest travel. They work between leather-covered guides, and their meeting edges are also covered with leather, for the double purpose of preventing noise and the escape of dust and effluvium. Other means, such as a treadle and lid action, are employed for effecting the necessary action of the inside mechanism, the mechanical arrangements of all being simple and effective, and unlikely to get out of order. The inventor has also turned his attention to commodes, &c., for hospitals and sick chambers, made in various forms of disguise, with a neat arrangement for removal while closed, so as to prevent unpleasantness when emptied.

The earth should be dry and finely sifted—a preparation best effected in summer, when about 25 or 30 hundredweight should be stored for a household of five or six persons, for a year. After use in the closet, the earth may be dried and sifted again for repeated use, when it of course becomes of increased value as a manure; or it may be thrown upon land and dug in. On no account should it be allowed to become wet by exposure to rain or otherwise. The very object of the earth-closet is to secure the dry treatment of excremental matters; hence moisture is its natural enemy. Disinfecting agents can be used with these closets, and are in some cases recommended, being capable of admixture with the earth in a dry form, or of use otherwise in the liquid shape. *Iron, December* 27, 1873.

§ *Fuel, Heating, Illumination, Photography, &c.*

Manufacture of Charcoal in Closed Vessels.—REICHENBACH states that the composition of wood may be regarded as being—

Carbon	40	per cent.
Oxygen and hydrogen combined in proportions to form water .	40	„
Hygroscopic water . . .	20	„
	100	„

When slowly distilled the hygroscopic water passes over first, then acetic acid of strength gradually diminishing as the distillation proceeds; finally come tarry products and combustible gases; if the distillation be stopped before the tar came over, *i. e.* when the acetic acid ceases to come over, what is known as "red charcoal" is left; this is quite as valuable for metallurgical purposes as the black charcoal finally formed when the distillation is carried to its utmost limit, and being less friable it bears transport better.

On an average 100 kilogrammes of hard wood yield—

Black charcoal	20	kilogs.
Tar	5	„
Acetic acid	5	„
Gases		

If red charcoal be produced, the yield is more than half as much again as there is formed of black charcoal.

The retorts for wood distilling are of cast-iron, or preferably of wrought iron, heated externally; brickwork furnaces heated internally are also used. To the distilling vessel is attached a worm-tube for the condensation of volatile products; the crude pyroligneous acid obtained at first is converted into lime salt, which is subsequently decomposed by sulphuric acid. *Bulletin de la Soc. Chim. Paris, xxi.* 138; from *Dingler's Polytech. Journal, ccix.* 449.

Substitutes for Coal.—Dear coal has called into existence many substitutes. Various kinds of patent fuel, depending more or less upon coal dust and slack for their production, have from time to time been brought into notice, and in some cases with fair success. Among recent aids to calorification chalk is mentioned. Experiments at Hatfield have shown that a mixture of seven parts of chalk to three of coal produced great heating power, and at Manchester the proportion of two of limestone to one of coal has produced great results. As an important product of this operation is lime, the new method presents certain attractions when carried out on a large scale, and, in fact, amounts to a proposition for utilizing the heating power generated in the limekiln. Special apparatus, however, is necessary, and, in the absence of exact *data*, it is impossible to speak confidently as to the commercial value of the system. In Belgium a scheme has been tried for saving 25 per cent. of coal by adding to three parts of small coal one part of vegetable mould mixed with a solution of carbonate of soda. This mixture is reported to have been completely successful, but no particulars are given as to the kind of stove necessary for burning it. By far the most important substitute for coal is peat, but the fact that during the present century about a hundred attempts in England, and about eighty in Germany, have been made to render peat manufacture a commercial success is not in itself very encouraging. To begin with, the raw material—the turf—varies immensely in quality, and it is only the lower stratum of a bog that is really worth the time and expense of manufacture. Thoroughly "masticated" by machinery, good peat may be compelled to relinquish a large portion of water, and when thoroughly dried, doubtless affords valuable fuel—but there are difficulties. The humid climate of the British islands demands that one of two modes of desiccation shall be adopted. Artificial heat may at once be dismissed as too expensive. Extensive sheds, well provided with a thorough draught of air, afford the other alternative, but this demands not only immense space but considerable time. Again, from six to eight tons of wet peat must be cut to produce one ton of dry fuel, an important consideration in days of dear labour. Peat is moreover very bulky and occupies from three to four times the space of its weight of coal, and only possesses—weight for weight—half the calorific power of good Wallsend or Silkstone. A careful consideration of these points tends to the conclusion that unless peat can be delivered at 30 or, at the most, 40 per cent. of the price of coal, its manufacture can hardly prove a commercial success. Recent experiments point to the truth that the real destiny of peat is to be converted into peat-charcoal. This industry, by the aid of the small "hand" peat-masticators long in use in Germany, might be profitably pursued in remote districts where peat is plentiful and labour is cheap. None of the objections to ordinary peat fuel apply to the same material when converted into charcoal. In many countries less favoured with coal than England, peat-charcoal has long been used for smelting iron, and it is not impossible that the ingenuity devoted to its preparation may succeed in reviving a long-forgotten industry. *Iron, Dec.* 13, 1873.

Incrustation in Boilers.—CHAMPION and PELLET state that the most certain mode of avoiding deposits and incrustations is to separate the calcareous salts from the water before its introduction in the boiler; incrustation is caused principally by the water containing both sulphate and bicarbonate of lime. In this case barytes, or a mixture of soda and lime, may be used with success. The authors occupy themselves especially with the deposits formed by the decomposition of the bicarbonate of lime under the influence of heat, and which causes such frequent accidents. The carbonate, acted upon by an excess of carbonic acid, takes with it, in precipitating, small quantities of greasy matter contained in the water, and the pulverulent deposit thus formed prevents the contact of the water with the sides of the boiler.

The mode proposed for preventing this, lately adopted on the Northern Railway of France, consists in the addition of milk of lime corresponding in quantity with the excess of carbonic acid. This system, however, which answered perfectly at some sugar works at the end of one season, was found inefficient in the following year; the authors have instituted further experiments, and state that when lime-water is introduced into water containing a certain amount of calcareous bicarbonate, so as to saturate the excess of carbonic acid, a flocculent precipitate of carbonate of lime is quickly formed; if the water is left quiet for a few hours, and filtered, it is then exempt from lime; if, on the contrary, the carbonate is less in quantity, no precipitation is formed, even by agitation after many hours. In this latter case the carbonate is in a condition of supersaturation, and possesses a considerable amount of solubility. This property alone, however, is not considered sufficient to account for the failure in question.

Comparing results, it appears likely that the non-precipitable carbonate might be removed by the formation in the water of an abundant precipitate of carbonate of lime, obtained by means of a soluble salt of lime; and such proves to be the case. It has been found, moreover, that the addition of certain pulverulent substances, such as silica, lime, or natural sand in fine powder, produce a like effect. It appears, therefore, that the presence of a precipitate, even of a foreign nature, causes a sort of disassociation between the water and the carbonate of lime, and the precipitation of the latter. The failure already referred to must have arisen from a variation in the amount of carbonic acid in the water, and consequently in the proportion of carbonate of lime dissolved; it is evident, therefore, that it is necessary to ascertain the amount of the carbonate of lime and the excess of carbonic acid in the water. In effect this excess furnishes, in contact with the lime, a new quantity of carbonate, which, added to the first, may cause precipitation.

From the above experiments and facts, the authors deduce the following general method of treating water, in which the proportion of lime is not sufficient to cause precipitation. It is sufficient to add a few thousandth parts of pulverized limestone to water already saturated by the proportion of lime corresponding with the excess of carbonic acid, but it is preferable to use carbonate of soda instead of lime, an excess of which would give rise to accidents, which we desire to avoid. Even oxalate of ammonia, active test as it is, will not show a trace of lime in water thus treated. After some hours' repose, the greater part of the carbonate is deposited, and what remains in suspension may be removed by filtration. The general inference drawn from the above is, that in the qualitative analysis of water destined for feeding boilers, it is necessary to ascertain the total amount of carbonic acid, and to operate afterwards on the dry residuum; sulphate of barytes in small quantities may present similar phenomena. *Paper read before the Society of Civil Engineers of Paris.*

Boiler Crust.—HAYES gives the following opinion regarding the formation of deposits in boiler flues:—They are of two kinds, both of which are capable of corroding the iron rapidly, especially when the boilers are heated and in operation. The most common one consists of soot (nearly pure carbon) saturated with pyroligneous acid, and containing a large proportion of iron, if the deposit is an old one, or very little iron if it has been recently formed. The other has a basis of soot and fine coal ashes (silicate of alumina), filled with sulphur acids, and containing more or less iron, the quality depending on the age of the deposit. The pyroligneous deposits are always occasioned by want of judgment in kindling and managing the fires. The boilers being cold, the fires are generally started with wood, the

pyroligneous acid then distils over into the tubes, and, collecting with the soot already there from the first kindling fires, forms the nucleus for the deposits, which soon become permanent and more dangerous every time wood is used in the fire-place afterward. The sulphur acid deposits derive their acids from the coals used, but the basic material, holding these acids, is at first occasioned by cleaning or shaking the grates, soon after adding fresh charges of coal. Fine ashes are thus driven into the flues at the opportune moment for them to become absorbents for the sulphur compounds distilling from the coals, and the corrosion of the iron follows rapidly after the formation of these deposits. *American Chemist.*

Disincrusting Powder.—MORTELETTE patents the use of the following composition for the prevention of boiler crust :—

Sawdust	25 parts.
Soda crystals	8 „
Carbonized colza	15 „
„ sapin	5 „
Wheat, potato, or other starch .	2 „
Virgin clay baked and powdered .	30 „

Bulletin de la Soc. Chim. Paris, xxi. 142.

Advantage of using Steam at very High Pressures.—A. RIGG states that there is a great advantage in using steam at a higher pressure than what is called low-pressure steam. If we take water at 33°, that is just above the temperature of ice, and that be warmed until it attains the temperature 213°, it would occupy a bulk 1,609 times as large as it was in the form of water. There is a relation between the pressures and temperatures which must be maintained in order to preserve the whole of the water in the form of steam. These relations are expressed in the first two columns in the following table. The third column expresses the resulting volume of steam. The fourth column is the product of the pressure and the volume, and, therefore, represents the mechanical value of our unit of water. How much and at what rate this value or power increases with an increase of heat, and a correspondent increase of pressure, may be known by considering the figures in this fourth column. These figures represent the advantage of using steam at high pressures, and, therefore, high temperatures :—

STEAM FROM WATER.

Pressures.	Temperatures.	Volumes.	Pressure multiplied by volume.
lbs.	Deg. F.		
15	39	1	
15	213	1669	25,035
25	240	1042	26,050
35	260	765	26,775
45	275	608	27,360
55	288	506	27,830
65	299	434	28,210
75	308	381	28,575
85	317	340	28,900
95	325	307	29,165

The reason why we cannot work steam at some of these very high temperatures is this, that when we superheat it, we thereby prevent any of it being converted into vapour, and if it is not so converted into vapour we have no means of lubricating the faces of our slide valves, and the consequence is, the metals being heated, they soften, then stretch and tear each other's faces, and the engine is soon destroyed. As soon as we can get slide-valves made of some material which will bear this higher temperature without abrasion or scratching, then, probably, we shall be able to work superheated steam economically. *Cantor Lectures, Society of Arts.*

Utilization of Waste Steam.—SPENCE proposes the following plan for the utilization of the heat of waste steam as a substitute for fuel. The method is founded upon a discovery made by the father of the inventor, and announced by him to the British Association at its meeting at Exeter in 1869. The discovery was that steam liberated at atmospheric pressure—that is, at a temperature of 212°—and passed into any saline solution having a boiling temperature higher than that of water, would raise this saline solution to its own boiling point. Thus, by blowing steam at 212° into a solution of nitrate of soda, which boils at 250°, the temperature of the solution will be raised to 250°, the steam being condensed and yielding up its heat. The explanation seems to be that the salt has a stronger affinity for the water in the steam as water than the heat has for it as vapour. The water is therefore seized by the salt, and the latent heat is evolved as heat of temperature. A single cubic inch of water made into steam at 212° will raise six cubic inches of water from 32° to 212°, which shows the enormous amount of latent heat which steam contains. In utilizing the exhaust steam (at 212°) from a high-pressure engine, Spence brings it into contact with a solution that has a boiling temperature higher than that of water. For this purpose he prefers to use a solution of caustic soda, on account of its high boiling point, and because it is not liable to act injuriously upon iron. The exhaust steam will raise a solution of caustic soda to a temperature of 375° (more or less, according to its density), and the heated solution is then circulated through pipes in an ordinary boiler, and its heat is radiated for the purpose of generating steam in the place of heat derived from fresh fuel. If the boiler is at a pressure of 30lbs. the solution will leave it at a temperature of 250°, so that 125° of heat would have been radiated to the water. The solution having been to some extent diluted by the condensation of the exhaust steam, its capacity for heat will be reduced in a corresponding degree ; and if steam at 212° were again blown through it, it would not reach the same temperature as before. It is therefore passed into another boiler of ordinary construction, where it takes the place of water, and is concentrated by steam being generated from it. In this way its original capacity for receiving heat is restored. Besides this method of utilizing the waste steam of high-pressure engines, Spence has found the principle equally applicable, and with even greater advantages, to the condensing engine. The solution may be brought in contact with the exhaust steam in an ordinary surface-condenser. A partial vacuum is produced, because, although the injected solution may be of higher temperature than the steam, its power of absorbing steam is comparable with that of cold water. The solution is again heated to a degree capable of generating steam, and the vacuum is produced. It appears extremely probable that, by taking advantage of this discovery, a mode of utilizing the large amount of latent heat contained in the steam now thrown into the atmosphere could be brought into practical operation, so that this latent heat could be made to do actual work ; the discovery, especially at the present price of fuel, would be one of enormous value ; the author proposes to try the experiment on a manufacturing scale. It has been objected to this project that the amount of tubing required for the conveyance of the caustic soda solution would be so large that it would eat up any profits likely to accrue from the discovery. On this point, however, the larger experiments about to be instituted must shortly remove all doubt.

Anemometers for Flue-Testing.—MACTEAR gives the following account of the several kinds of anemometers that have been used in flue-testing in recent years, and more especially since the Alkali Act came into operation.

The original form of anemometer was the simple **U** tube filled with water, and with one limb connected, by means of a tube, with the flue or chimney to be tested. It is found, however, that it is quite impossible to obtain accurate results with this instrument, and the method has been adopted of cementing it to the flue with two tubes, one being straight and the other bent at right angles at the end. These are placed in the flue with the straight one just flush with the inside, and the bent one in the current, with the open end facing it. The principle on which this double tube acts is as follows :—By using a simple open straight pipe an indication is obtained, which is due not only to the speed of the gases in the flue, but also to the difference in the density of the outside air and the gases in the flue, while by employing two straight pipes, the action on each would be the same. On the other hand, when the plain and bent tube is employed, a different action takes place, a current of air passing across the straight tube creates a partial vacuum, and the bent tube receives the full force of the current ; and as these two forces are combined in the same direction, they raise the level of the liquid in the tube to a height which is equal to double the moving force of the current.

By the use of water in the **U** tube, it is found that the difference of the levels in the tube at ordinary flue-speeds is too small to be measured accurately, and not only so, but the movement in the tube is very sluggish, owing to the adhesion of the water to the glass. Fletcher found that by using a balance, one scale of which was replaced by a flat plate which was carefully brought down on the surface of the various liquids tested, in the case of water a weight of twenty grains in the other scale-pan was required to lift the plate from the liquid, while with ether one one-hundredth of a grain was quite sufficient. Swan also found that a bead of ether, so small as only to weigh three one-hundredths of a grain, would descend in a capillary tube by its own gravity, so small in amount is the adhesion and friction. This

substance has, therefore, altogether superseded the use of water in anemometers for general use.

An instrument has been invented by Hoey, in which both water and oil are used (the latter being a little heavier than the water), embodying an ingenious method for increasing the difference of the level. This consists of a U tube, having a bulb blown on each limb. The readings are taken at the surface of the oil, which is contained in a tube, of say one-eighth of an inch bore, while the water extends into the bulbs, which are, say two inches in diameter. As the pressure acts on the larger surface, the motion is communicated to the oil in the tube, the travel of which is increased in proportion to the ratios of the arrears of the bulbs and tube. In this case it would be as sixty-four to one, a difference of one sixty-fourth of an inch showing an inch in the small tube. But as the friction in this instrument is very great, it is necessary to construct the scale for it by actual experiment. This is also necessary on account of the two bulbs being seldom of the same size.

This instrument has not got into general use, nor does the author think it likely that it will do so, as Fletcher's improved instrument is much more convenient in every way. It consists of a U tube filled with ether and a convenient Vernier for reading off the indications. It is connected by means of tubes with the flue to be tested, and the figures noted; and then by means of a table there is directly obtained the speed of the current in the flue. The inventor found that, in a flue constructed for the purpose, a speed of 28·55 exerts a force equal to sustaining a column of ether of one inch in height, and the table was constructed in accordance with this basis of calculation. The weak point of the instrument is said to be its indicating only a very small difference in level at low speeds; for instance, a speed of about one foot per second only causes a variation of one-thousandth of an inch, and a speed of five feet only three-hundredths.

A very handy form of instrument has been introduced by Swan, which does away with this objection to a great extent. He places the U tube at an inclination of one in ten, thereby increasing the range by ten, so that for a speed of one foot per second the difference of level in the two limbs of the tube is one-hundredth of an inch, and for a rate of five feet per second the travel is three-tenths of an inch. The whole instrument is very well designed, and very convenient, while for high speeds it can be set perpendicularly, and used as Fletcher's instrument.

In testing flues or chimneys, it is necessary to take great care not to put the tube into an eddy of the gas, as is sometimes done, the instrument being made to indicate a pressure outwards rather than a suction. This is very common at the base of chimneys, and therefore the author recommends the testing to be conducted 20 or 30 ft. from the base. The following results were obtained recently in testing some large flues—6 ft. in diameter—which show great variation in the speed at various parts of flues. One flue, which was tested downwards every 3 ft. showed at first a speed of 10·53 ft. per second, the highest speed being 29·40 ft., and the speed at the base being 12·70 ft. Another flue, which was tested in a somewhat similar manner, showed at first a speed of 4·04 ft., then in the middle a speed of 12·93 ft., and at the end 4·04 ft. A large horizontal chimney flue, tested every foot, gave speeds ranging from 6·38 ft. up to 37·77 ft. and down to 12·77 ft., which show that there must have been a great amount of friction on the sides of the flue. The highest speed just named—37·77 ft.—is about as much as one can stand against in the confined space of a flue.

The author exhibits another piece of apparatus invented by Fletcher, the use of which is to obtain average samples of the gases in a flue or chimney. The arrangement consists of a fine aspirator, worked by the rush of air into the flue, which, in its turn, works a train of wheels, and puts in motion a small bellows, the action of which is to pump out slowly a portion of the gases and draw them through the test solutions. Its use is chiefly for testing hydrochloric acid gases in flues and chimneys, the quantity pumped out being registered by an index, and that pumped out in a given time being thus easily found. *Paper read before the Glasgow Philosophical Society.*

Manufacture of Gas.—D. A. GRAHAM patents the following improvements in the manufacture of gas, and in the apparatus employed therein. These consist in distilling coal in the ordinary manner, passing the gas through horizontal condensers, and conveying the tar into stills or boilers where the naphtha or other illuminants in the tar are converted into vapour or permanent gas. These stills or boilers may also be used to distil any other suitable liquid or substance for the same purpose. In a separate boiler, steam is generated and decomposed by passing it through a red hot tube filled with iron borings. The hydrogen made is then mixed with the gases formed in the stills, together with ordinary coal gas. The mixture is then exploded by passing an electric spark through it, and converting the contents of the chambers in a permanent gas of great volume. By this process the bisulphide of carbon is converted into sulphuretted hydrogen, which can be removed by the oxide of iron purification.

Spent Oxide from Gas Purifying.—G. E. DAVIS finds these oxides to be composed as follows:—

	I.	II.	III.
Sulphur	64·376	62·358	67·956
Ferric hydrate	14·421	17·112	15·335
Insoluble	11·052	5·099	8·304
Moisture	2·079	5·387	3·900
Lime (combined with Sulphur)	2·399	—	—
Sawdust	2·470	1·776	1·002
Calcium carbonate	—	5·135	3·006
Ammonium sulphocyanide	2·662	1·324	1·102
„ chloride } „ cyanide }	0·605	—	—
„ ferrocyanide	—	1·663	—
Iron ferricyanide	trace	0·366	trace
	100·064	100·220	100·605

The following is the analysis of a sample of the burned oxide:—

	Wet.	Dry.
Moisture	15·228	—
Insoluble	28·302	33·386
Ferric oxide	44·420	52·399
Calcium sulphate	11·288	13·315
Sulphur	0·762	0·200
	100·000	100·000

Chem. News, Jan. 23rd.

Coloured Tapers.—J. MACFARLANE finds that the green wax tapers of commerce frequently contain an amount of arsenic (as Scheele's green) which is highly deleterious, as arsenious oxide becomes disseminated through the air of the apartment during the burning of such tapers. Red tapers often contain vermilion, and impregnate the air with mercurial fumes. In one instance 1·66 per cent. of mercuric sulphide was found; in another 1·93 per cent. A green taper contained about 0·6 per cent. of its weight of arsenic; another about 1 per cent. Some blue tapers examined were harmless, being coloured with ultramarine; yellow tapers, coloured with chromate of lead, are harmless as regards injuring the air, as are, necessarily, white tapers. *Paper read before the Glasgow Philosophical Society.*

Refining Oils, Petroleum, &c.—BANCROFT refines oils for machinery and lubricating purposes generally by agitating them with a ley of caustic soda 1·2 sp. gr.; a sufficient quantity has been added if, after standing, a portion begins to settle down clear at the bottom. About 4 to 8 per cent. of the soda solution is commonly required for lard and olive oil. After standing for twenty-four hours, the clear supernatant oil is decanted from the soapy sediment and filtered. *Chemical News.*

Resin Oil.—Crude resin oil being generally turbid, fuller's earth, as well as other varieties of clay, is sometimes used as a clarifier. The powdered clay is mixed with the oil, stirred, and when it has subsided to the bottom of the tank, the oil is filtered and comes out quite clear. But this is not literally *refined* oil. Crude resin oil contains a certain proportion of undecomposed resin, pyroligneous acid, liquid hydrocarbons of widely different boiling-points, also solid homologues of naphthalene. To refine this crude oil it is necessary to re-distil it with slaked lime, and separate the successive products of the distillation. *Chemical News, xxviii.* 326.

Chemical Action of Light.—E. MARCHAND proposes to use, as a means of measurement, the action of light on a mixed solution of ferric chloride and oxalic acid. The energy of the light is measured by the amount of carbonic acid evolved, one cubic centimetre of gas being equivalent to 0·001356 calorimetric degree. The most effective rays are those between Fraunhofer's lines F and G of the spectrum. In the hydrogen and chlorine photometer of Bunsen and Roscoe, the most active rays are those between G and H. *J. Pharm. Chim.* [4] *xviii.* 417.

Preparation of Bromized Collodion.—Dissolve in 100 c.c. of alcohol 2 grammes of bromide of cadmium and 0·5 gramme bromide of ammonium; add to the mixture 2·5 grammes of papyroxyl (paper converted into nitro-cellulose) and 150 c.c. of sulphuric ether. Introduce into the solution 0·8 gramme of yellow gum-lac in scales, which are dissolved by the aid of the water-bath. Finally, 4 drops of pure nitric acid are added.

After resting from two to three weeks, the collodion is ready for use. To render this collodion sensitive, an hour before the layer is required, use the following solution of nitrate of silver. Put into a test-tube of about 12 centimetres long and 15 millimetres in diameter, 1 gramme of crystallized nitrate of silver in fine powder, and 4 c.c. of rectified alcohol, to which 1 drop of distilled water is added. The mixture is carefully heated till the nitrate is dissolved, and the solution is immediately poured into 50 c.c. of the above described collodion decanted previously into a small wide-mouthed flask. This operation is performed in the dark. It is well shaken for some seconds, allowed to settle for an hour, and the emulsion decanted into a second bottle. The plates are covered with the collodion thus prepared, the excess being each time allowed to flow back into the bottle. The prepared plates are washed with rain-water, so that they may be quite free from undecomposed nitrate of silver, and are then set to dry, or before drying they may be coated over with some preservative, such as tannin, dextrin, or acetate of morphia. The backs of the plates should be coated with some black or yellow colour. *Development.*—After having softened the sensitive layer by the aid of a mixture of equal parts of ether and alcohol, the quantity of water necessary to cover the plate is put in a developing glass, and a few drops are added of an alcoholic solution of pyrogallic acid containing 15 per cent., and a drop of an aqueous solution of carbonate of ammonia of 10 per cent. *Chemical News;* from *Bulletin de la Soc. Française de la Photographie, No. x.* 1873.

Modification of the Collodio-Bromide of Silver.—J. F. PLÜCKER remarks that this process is the most simple known, and yields results as good as, if not better than, those of the iodide and the silver bath. It has, besides, the advantage of rapidity in the preparation of sensitive surfaces, and that of avoiding the use of a costly solution of nitrate of silver. The development of the image is very regular. The sensibility in respect to objects which reflect abundance of chemical rays is the same as that of surfaces of iodide and iodobromide of silver, but it is greater for feeble rays such as those issuing from verdure-shaded parts, &c. *Chemical News;* from *Bulletin de la Soc. Française de la Photographie, No. x.* 1873.

§ 6. *Miscellaneous.*

Steam Sawn Metal Work and Zinc Foil Decoration.—C. H. COOKE describes a style of decoration new in this country, but which has been adopted with good effect in France for some time past.

The author said that he was desirous of drawing the attention of the members of the Institute to a new mode or operation of metal working, recently perfected in Paris, and applicable to iron, brass, and zinc; this, without any attempt to imitate wrought or cast iron, combines the advantages of both, and is termed "cut work."

The cutting of these metals is effected by a steam saw, the hardness and make of the saw being in reality the secret of the whole work; this offers the greatest facilities for the conception and working out of the most intricate and delicate design obtainable by no other means. The zinc work, it is believed, will stand in this country, as at Paris, the effect of the weather without painting.

This method of cutting through hard metals has been brought to great completeness, and by it can be cut brass and copper three inches thick, and wrought iron one inch thick. The face of the work can be chased or engraved as desired; and after the pattern required has been cut by the saw it can be heated, and the twist to the ends or points so frequent in wrought work can be given, and certain portions of the ornamental work raised or depressed as desired; this forms a combination in metal working hitherto unknown. *Paper read before the Royal Institute of British Architects.*

Utilization of Blast-Furnace Slag for Building Purposes.—TUNNER granulates the slag by running it into a stream of water whilst still in fusion; from one quarter to a sixth of its weight of lime is then added, and the whole pressed into brick-shaped masses, which are allowed to dry in the air. The more basic the slag, the less lime is added. After several weeks' exposure to air, the bricks are extremely hard, and can be used for building purposes. The following is the cost of making these bricks of the ordinary size:—

2½ tons of granulated slag at 0·1875 franc per ton	0·95 francs
Lime	5·00 „
Machinery	1·30 „
Water and fuel	1·25 „
Wages	4·00 „
	12·50 francs

or 12·5 francs per hundred (query per thousand?). *Bulletin de la Soc. Chim. Paris, xxi.* 88; from *Dingler's Polytech. Journal, ccx.* 270.

Plumbago.—O. CLEVELAND describes various uses to which plumbago is put, and several methods for using it to the best advantage. The mineral is found mixed with iron compounds, carbonates of lime and magnesia, and other earthy matters, which greatly interfere with its application to certain purposes. For making pencils the crude plumbago is powdered and washed with water; the pure graphitoidal particles are washed away, and are obtained by subsidence from the liquors; various qualities are thus obtained, according to the length of time required to form the deposit. The powder is compressed into blocks, and cut into the shapes required for pencils; these are then heated in a crucible, from which air is excluded; they are thereby hardened and rendered fit to put into cedar cases for commerce. Various degrees of hardness are attained by mixing different quantities of clay with the plumbago; the more clay the harder the pencil.

For crucibles particularly pure varieties are required; the presence of lime is specially hurtful. No more clay is added than is required to give a proper moulding consistency. When made and baked the crucible should be kept in a dry place, and heated gradually when used for the first time. With proper care a crucible may serve for from 20 to 48 fusions of brass, copper, gold, silver, alloys, &c., &c.; some have been known to last for from 60 to 80 times. With steel, however, a crucible will only serve from 6 to 8 times. The duration of a crucible may be increased by carefully cleansing it from scoriæ each time it is used, and covering its surface with a mixture of refractory clay, plumbago, wood, charcoal, and silica; fine quartzose sand is the best. Pounded gas carbon is preferable to wood charcoal, but cannot always be obtained.

For polishing stoves, &c., good plumbago is requisite; in any case, the more finely it is powdered, the better; the best method of use is to make up the powder to the consistency of cream with water, spread the liquid on the surface to be blacked with a brush, and then polish the surface with a dry brush (as in blacking boots). So-called "polishing liquids" are to be met with in commerce; these usually consist of plumbago of more or less good quality suspended in water (coloured with soluble blue or other dye stuff,) or in petroleum spirit, &c.; in all cases the plumbago is the sole active ingredient, and can be obtained by itself far more cheaply than these so-called "inventions."

For lubricating, the plumbago must be of the finest quality, and well elutriated by water before use; under the microscope it should present the appearance of very small grains, not of scales; this is accomplished by using special stamping machines to pulverize the plumbago before the washing process is commenced; the water may be acidulated with sulphuric acid with advantage, whereby carbonate of lime, &c., are removed. When really pure plumbago is used, no substance is superior to it as a lubricator; but unfortunately many of the commercial articles are much adulterated, whereby a great deal of the peculiar anti-friction virtues are lost.

For galvanoplastics, the very finest plumbago only can be employed; inferior kinds possess too little electric conductivity. *Moniteur Quesneville, December,* 1873, *p.* 1087; from *Chronique de l'Industrie.*

A New Barometer.—JOULE has devised the following form of barometer:—A tube of about 3-16th inch bore is selected. It is first cleaned by drawing a knotted string through it. It is then bent to a syphon-shape, and near the longer end it is drawn to a capillary tube. It is then washed with nitric acid, afterwards with sulphuric acid. The sulphuric acid is then drained off. Mercury is then poured into the short limb. The end of the longer limb is then attached to a mercurial exhauster. On working this, the mercury rises in the tube, and, being replenished by pouring it into the short limb, soon arrives at the height due to the atmospheric pressure. It carries with it the acid left adhering to the sides, so that, after a few hours, half, or, what is better, one-third, of an inch of acid stands above the mercury. Small bubbles of air are seen to arise, but, by leaving the tube in connection with the exhauster for a day or two, these finally cease. Mercury is then poured into the short limb until that in the longer rises nearly to the capillary part of the tube. This is then sealed and detached from the exhauster. Mercury is then removed from the shorter limb until it stands in the long one at a convenient height. Sulphuric acid is then introduced into the short limb until it forms a column equal to that in the longer limb. A small tube is finally attached to the short limb, and dipping a little way into a small bottle containing a small quantity of sulphuric acid, prevents the access of moist air into the short limb.

The tube thus completed possesses the following advantages:

—1. There is the utmost facility in the movement of the column, so that the most minute changes of pressure are at once registered without any dragging. 2. The depression produced by capillary action is reduced to one-half. *Paper read before the Manchester Literary and Philosophical Society.*

Gun-cotton.—BOETTGER gives the following means of determining when gun-cotton has been imperfectly nitrated, *i. e.* when ordinary unaltered cellulose is present. When boiled for ten minutes with a solution of stannite of sodium, the gun-cotton is wholly dissolved, whereas unaltered cotton is unaffected; on addition of hydrochloric acid to the solution, regenerated cellulose is precipitated. *Dingler's Polyt. Journ. ccix.* 515.

Dynamite.—P. A. BERKLEY states that dynamite is of a light brown colour, and when in a proper state for use is of a pasty consistence. It should be kept at about 50° or 60°; when cold it is not so effective. Dynamite explodes at 420° F.; when set fire to it quietly burns away. It always explodes when a lighted match is applied, never without, and it never hangs fire. It has been tested by a case containing 56 lbs. of dynamite being thrown from a height of 130 feet into a quarry, and it did not explode. It explodes in one-twentieth of the time it takes gunpowder, and is three times as powerful. With its rapidity of explosion the downcast force, although not confined, is strangely great, as instanced in a block of iron, 2½ feet by 1½ feet, being broken in two by about 1 lb. of dynamite, whereas powder had no effect. Dynamite in exploding does not scatter the fragments about like gunpowder, unless the hole has been fired two or three times, and become much shattered. There is no stythe from it like gunpowder, and therefore in that instance it is well adapted for mines where the ventilation is not good. Dynamite is most valuable for blasting among water, as no damp affects it.

The using of dynamite is very simple; it is supplied from the manufactory in cartridges about 3 inches long and about 7-8ths of an inch diameter, weighing between 2 and 3 ounces. A special fuse is made for it, but any ordinary fuse will answer. The end of the fuse is cut clean and square, and inserted into a special cap or detonator; the cap is fastened on to the fuse by a pair of nippers (a little tallow may be put upon the joint to keep any water out of the cap); the cap is then inserted into a small cartridge called the primer; the parchment having been opened to receive it is tied over the fuse to prevent its coming out of the cartridge; the hole that has been drilled is filled with water, and a sufficient number of cartridges put in, and each pushed home by a piece of wood (iron should not be used), so as to fill the hole, and all come close together; on the top is placed the primer cartridge, with the fuse attached, and cut to a sufficient length to let the men get away. The hole being filled with sand—or water, which is better, as water does not in the least injure its action, the fuse is fixed, which communicates with the fulminating powder in the cap, and explodes the dynamite.

Frequently, if the block is large, the first explosion will not break it, but the hole will have been made more than twice the diameter, so that double the quantity of dynamite may be put in the second time, which is pretty sure to do execution.

New Hydraulic Cement.—E. F. A. SCHOTT gives the following prescription for the manufacture of cement:—

Natural anhydrite is reduced to a coarse grained or fine powder, and mixed with 73·5 per cent. of limestone powder or chalk. The mixture thus obtained is heated in a puddling furnace so that it becomes liquid, and then it is crutched by means of iron tools through a side opening and cooled. The furnace is then again filled. To melt the mixture the well-known furnace of Siemens, as employed to puddle pig iron, is used, or any other furnace by which a temperature of 2000° C. can be obtained, the melting of the mixture being only obtained at a full white heat.

If the limestone is difficult to pulverize it may be first burned and reduced by slacking to powder, the subsequent operations being the same in either case.

Where anhydrite is not conveniently obtainable other material may be employed consisting of sulphate of lime. The melted mass is reduced by machinery to a powder of different sizes which forms the cement ready for use. The coarser, of which the grains are of the size of gunpowder, is principally used as cement for hydraulic work, whereas the fine powder is applied to stucco work. The latter is mixed with a slight quantity of water, and the wetting and hardening of the mass is finished in from ten to twenty hours. A mass of the coarse grained powder caked in water becomes hard in about a month, one of fine powder in from eight to fourteen days. The coarse grained mass thrown into water sinks and hardens very slowly but very effectually.

The new cement takes up water slowly, but otherwise it has the same qualities as Portland cement, of which it may take the place in nearly all cases. It is distinguished from almost all other cements by its light colour, and can be used in more cases, as it may be applied to stucco work and the manufacture of artificial marble.

The cost of manufacture is less than that of Portland cement, because the raw material is very cheap, and being mixed in a dry state the mixture need not be made very carefully. The effect of fuel is much greater in puddling furnaces than in intermittent blast furnaces as used generally in the manufacture of Portland cement. The moment when the gypsum cement is burned can be easily ascertained by any workman, and no loss is occasioned by unfit or overburnt products.

Density of Aqueous Solutions of Glycerine.—SCHWERKERT gives the following table deduced from his own experimental researches.

Specific gravity.	Percentage of water.	Specific gravity.	Percentage of water.
1,267	0	1,185	26
1,260	2	1,179	28
1,254	4	1,173	30
1,247	6	1,167	32
1,240	8	1,161	34
1,234	10	1,156	36
1,228	12	1,150	38
1,221	14	1,145	40
1,215	16	1,139	42
1,209	18	1,134	44
1,203	20	1,128	46
1,197	22	1,123	48
1,191	24	1,118	50

Bulletin Soc. Chim. Paris, xxi. 91; from *Dingler's Polytech. Journal, ccx.* 318.

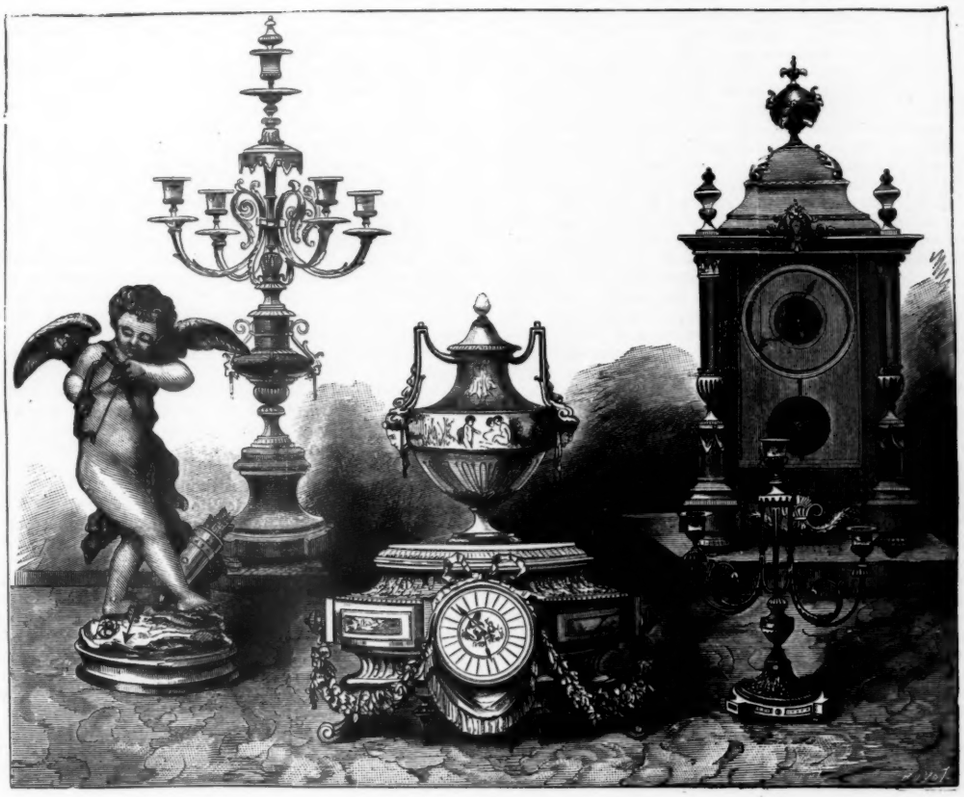
Preservation of Wooden Labels.—The following method of preserving wooden labels that are to be used on trees or in exposed places is recommended. Thoroughly soak the pieces of wood in a strong solution of sulphate of iron; then lay them, after they are dry, in lime-water. This causes the formation of sulphate of lime, a very insoluble salt, in the wood. The rapid destruction of the labels by the weather is thus prevented. Bast, mats, twine, and other substances used in tying or covering up trees and plants, when treated in the same manner, are similarly preserved. At a recent meeting of a horticultural society in Berlin, wooden labels, thus treated, were shown which had been constantly exposed to the weather during two years without being affected thereby.

THE HISTORY OF TECHNOLOGY.[1]

SECOND AND CONCLUDING NOTICE.

WHILE, with the author of this volume, we are bound to pursue our survey of the history of technology in a strictly utilitarian sense, it is scarcely possible to avoid an acknowledgment to centuries long antecedent to the eighteenth century, in reference to the value of trade guilds and corporations. It is impossible to doubt that had not the rude corporations of artificers persistently fought their way in times much more remote from us, the more refined organizations possessed by us in modern times lying immediately behind and about us, would not have existed, or, at least, have not existed in their present elastic and useful form. Nor should we measure those times by our own. In all essentials the artificer of the period of the *renaissance* was our superior; his work better done, and, what is very germane to the matter, his mind more at ease. Our present semi-political trades' unions, and yet more such a body as the International Society, would have amazed, if not terrified, the handicraftsman of the year 1700. All kinds of labourers are apt in seasons of dearth and doubt to look longingly towards some Utopia of labour; but, if we may judge by experience, the Utopia of one age is by no means the Utopia of the next. Nor is the present day very reassuring as regards the future. When we see

[1] *Geschichte der Technologie seit der Mitte des achtzehnten Jahrhunderts, von Karl Karmarsch.* München, 1872. R. Oldenbourg. History of Technology from the Middle of the Eighteenth Century, by Karl Karmarsch.



GEMS OF THE VIENNA EXHIBITION.—BRONZES EXHIBITED BY M. DOMENGE ROLLIN.

on every side a body of artificers obstinately combating the inevitable exigences of political economy, it does not seem highly probable that, having taken the wrong path to the workman's heaven, those who pursue it are ever likely to get there. Increase of wages, perhaps, may be conceded as a consequence of the increase of price in articles of food, raiment, lodging, and the like; but as that increase of wages at once produces a further rise in prices, the whole machinery of labour is much in the same ratio of progress and actual social condition.

Increase of wages has hitherto led to an increase in the consumption of luxuries, not necessities, in the worker; and with such luxurious habits sets in a disinclination for labour, a consequent dissatisfaction, only preparing the way for further agitation, again, in pitiless inevitable sequence, leading to further calamities to the actual mechanic. Now the triumphs of the early guilds were not due to this kind of restless agitation, but to a movement seen to be wise by all parties concerned. Rulers of land, proprietors of land, possessors of capital, and all other encouragers of the industrial arts, were in no way averse to the introduction of means for the alleviation of the condition of those who did the mechanical portions of the work; on the contrary, they felt that the security and well-being of states were best promoted by what they might then regard as concessions, but which we must historically perceive to have been necessities; hence in granting to the various trades corporate and civil rights they were only preserving in a duly graduated scale the absolute integrity of civilized life. Nor were they wrong in demanding guarantees from such corporations that the limitations stipulated for between the contracting parties should be observed. These very limitations expressed, in a tacit manner, a kind of mutual respect very little thought of in these more recent days, when capital and labour are thought to confront each other in hostile ranks. But it would seem vain in a thousand ways to preach the truth, that strikes hurt no one but the immediate supporters of them, that the instigators of them never suffer, but live idly upon the percentage they obtain from their hard-worked and hood-winked brethren; nor is it of any use to reiterate that capital can never be paralyzed in the same sense as labour. Capital never eats and drinks, while hungry workmen, their wives and children, do; and the workman cannot see that it is the poorest and most pinchbeck kind of heroism, besides being the most ruinous policy, to leave the home cupboard bare and the poor hearth fireless, to fight the battle of labour under the flags raised at public-houses and upheld by talkative and illogical paid agitators. It was far otherwise in the days when the trade guilds solicited recognition at the hands of the state.

It must be admitted that the condition of the skilled artizan in feudal times was most miserable, that even the comparatively intelligent merchant-class was oppressed to a degree hardly conceivable at the present day, and that the lowest stratum of labourers—the "residuum" of Mr. Bright—was in a state of most pitiable degradation and physical and mental suffering. Therefore it was not surprising to find such necessary departments of labour in a state of chronic revolt, and veiled, if not open, rebellion against landholders and other privileged classes. That the trades then should combine in a common protest against the tyranny of the consumers, so soon as they found themselves strong enough, was a natural and inevitable consequence; the greater, indeed, the resistance shown by the higher classes, the more obstinate and inveterate the combat, the more emphatic the self-assertion of the artizans. Hence rules were adopted in each trade to avoid and prevent the intrusion of semi-skilled interlopers, and these rules, tending in the main towards the preservation of national order, received the approval and sanction of the authorities in the state. These rules of the various trade guilds, however, not only protected the artizans *inter se*, but to some extent regulated prices so far as labour was concerned, provisions being agreed upon limiting the numbers of masters, journeymen, and apprentices within a certain area or district. These last provisions tended to elevate the social condition of the workman, giving him a greater share in proportion of this world's necessities and luxuries, thus, in fact, fostering a greater feeling of independence and self-respect. The mental condition of the workman being thus improved gradually led to the emergence of the skilled workman from his former condition of serfdom, and the foundation of the middle class—now so justly powerful—was laid; thus society owes a great debt of gratitude to those men who in times past strove with energy and insight for a proper organization and orderly administration of labour functions. Intelligence increased, and with the growth of intelligence arrived that long series of modifications by which the condition of the labourer was so far ameliorated as to fit him for a part in the government of his country.

For a long period it has been the fashion, on the other hand, to run down and cover with obloquy the very idea of a system of society founded upon feudal arrangements. That the power of the territorial lord was enormous, is not to be doubted, but, despite of much authentic evidence of oppression, it would have been impossible for the arts and manufactures to have taken their proper rank in civilization without a class of society able and willing to foster them. Many of the masterpieces preserved to us in our museums and private collections were produced during this period of almost unlimited power on the part of the aristocracy; and had not the great body of this aristocracy possessed an innate sense of beauty and a wish to promote the more delicate and refined arts of life, we should still have been in a very rude condition of social life. Many trades, indeed, at present existing are by no means of the importance they were in those far-off days. The armourer was then a respected artificer, the tailor an important assistant in the beautifying of society; and fallen as our present age has to a dead and uniform level in the point of dress, his influence has consequently declined as a practical artizan. It is a natural consequence of an equalization in the ranks of society; but our forefathers, with a pardonable vanity, emulated each other in costume, and thus helped to maintain an important branch of industry, employing many busy hands and filling many hungry stomachs. The changes produced by time tend, of course, to injure one class of workers at the expense of another, and that great temporary suffering was produced by the abandonment of picturesque and expensive costume is beyond question. The sumptuary laws made from time to time show how necessary it was to put some check upon costume, and their provisions also teach us how unpopular the interference with dress was with the people at large. Finally, at a fitting time, these laws were abrogated and neglected, and an abatement took place in that particular and extensive trade.

Some readers may think it strange that of all the trades the present writer should have selected for comment the sartorial art; but has not Mr. Carlyle shown that the whole of society is actually founded upon cloth? Besides, behind the tailor stands the weaver; and is not his art assisted by the mightiest technological triumphs of machinery, chemistry, commerce, and metallurgics? *Eheu fugaces!* we can ill spare any item of the great social fabric, and least of all can we dispense with the knight of the thimble and shears; and though our chivalry may be shrunk to half-a-crown, the needle remains more important than the lance.

To return to Professor Karmarsch. "It is," says he (pp. 89-90), "a natural and general trait of humanity by which those who have a community of interests to preserve and foster, draw closer together, that upon it hangs as by a kind of instinct, the whole social fabric, and therefore actually its prosperity, nay the very existence of the race. From the largest associations—those of nations—by numerous grades down to family existence, we may observe this desire. The more evident the common interest, the more threatening the exterior obstacles or dangers—the more intimate becomes this bond of union; but precisely as in proportion to the relaxation or extinction of this impulse, there arises room for secondary objects, or individual interests come to the front, there also appears a danger of degeneration. This union being weakened leads to an existence without inward solidarity, and even to extinction, produced either by inherent rottenness or by outward assaults. As in general matters—so also in trades—this in a few words is the history of the trade guilds."

The trade guilds of Germany—originally associations of workmen in similar branches of labour, were formed shortly after the establishment of towns, and attained the apex of their influence after the severe contests they sustained during the thirteenth and fourteenth centuries with the patrician classes. At the termination of this struggle they had succeeded in many places in obtaining and retaining for themselves a portion of the municipal government, thus becoming political corporations. Upon their stamina and interior organization in those days of destruction, of the weakness of almost all crowned heads, of the arbitrary power of the nobles, rested the security of the towns—then the sole centres of all arts and manufactures. They were, in a certain sense, colonies in which were nurtured an energetic spirit of citizenship, they were schools of modest assurance and respect, although spiced with a leaven of prejudice—and they gave rise to an emulative strife ending in individual distinction. The political power of the guilds, however, declined during the ecclesiastical strife resulting from the Reformation, and the gradual growth of the influence of the landholders in the towns, and they fell into utter desuetude in consequence of the disorders arising from the Thirty Years' War. This would have been the time to have endowed them with new weight by directing the organization towards a remodelling of trade exigences. But in place of such a healthy reconstitution, the guilds adopted narrowminded and jealous exclusiveness as a policy towards each other—they made an obstinate stand upon exceptionable trade regulations—the difficulty of entering upon membership was enhanced, and many rude and senseless formalities were regarded as things essential

to the prosperity of the guilds. Hence, in the eighteenth century, these bodies, and with them the whole condition of the mechanical class, appear in a very low state, and it was very difficult for government to contend with and suppress the grossest abuses. This downward tendency was promoted by many other influences of a most unfortunate character during the last hundred years—rendering their condition worse and worse. While general culture was increasing, and thence giving rise to higher social requirements at their hands—the majority of the guilds continued to select their apprentices—and therefore the future masters—from the least instructed classes; progressive and technical schools were neglected, or, if attended at all, supported with dissatisfaction, and the custom of sending out the journeymen, intended at first as a measure of great utility, degenerated into a spiritless and aimless vagabondage. Every moral influence of the master on the craftsmen became impossible, the latter being no longer regarded as members of the family; indeed, they at length revolted and emancipated themselves. Again, it was no uncommon thing to burthen the candidates by silly or expensive masterpieces—or judge their masterpieces with injudicious severity or partial laxity, while the suggestions of others outside the guilds were neglected or even persecuted. While the natural sciences and the practical application of mathematics were making great progress—the mechanic took no heed; great factories arose and spread abroad, competing severely with the mechanic—who generally encountered this competition by the most shortsighted measures. Finally, those who belonged to the guilds no longer regarded their position with respect, but looked upon the duties they were bound to perform as an odious burthen, and the more intelligent of their number abandoned their crafts altogether, passing over to the factory system. All this tended to destroy the former authority and value of the guilds, and thus led to their practical extinction.

The very low ebb to which these institutions had fallen may be seen by the statistics furnished by Professor Karmarsch. In Würtemberg, for instance, of forty-two guilds which remained in existence in the year 1828 in full power, there existed at a later period only with partial powers, three from the years 1555 to 1595, eight from 1606 to 1650, fifteen from 1651 to 1700, nine from 1701 to 1720, six from 1721 to 1750, and one from 1782. In the city of Hanover in the year 1868, guild letters of authority existed in force, two of the year 1571 and 1598, three of the seventeenth century, seventeen from the years 1710 to 1745, two from the second half of the eighteenth, and only five from the first half of the nineteenth century. The master workman was often prevented from attaining excellence in his art by the division of similar or connected branches of work between different guilds—and his activity was circumscribed within the strictly defined limits of his guilds—this led to a number of disputes between the guilds by no means advantageous to their solidarity. In fact they had grown into anomalies—and anomalies are ever self-destructive. For instance, in Hanover, the turners had the special privilege of using the lathe, while the tinmen alone had the right of working in tin. When about 1834 or 1835 the manufacture of hollow tinware by means of the lathe was introduced—if the guild had been strong enough to prevent it, this important branch of industry might have been at once suppressed—as the one guild of artificers could only work in tin and the other use the lathe. But perhaps the most extraordinary test of mastership existed in Vienna up to 1820, among the tailors. The candidates being assembled the professor of cutting out chalked out upon a large board the outlines for the coronation robes of the Emperor Joseph II., the robe of the order of the Golden Fleece, or some other choice piece of apparel. This was repeated three times and then rubbed out—whereupon the poor candidate had to reproduce the drawing from memory upon the board, or submit to failure. So jealous were the guilds of their rights that they even persecuted poor women who dared to make clothes for persons of their own sex!

The motto "Freedom for labour!" had, however, been already proclaimed in the seventeenth century, but governments were very slow in giving effect to this palladium by the enactment of trade laws and ordinances. Before this occurred the guilds were silently undermined in various countries by a system of concessions; this began in Austria in or about 1776, in Bavaria in 1807, 1825, 1834, and in Würtemberg in 1835. In this way a number of small trades were created, but hotly persecuted by the guilds. As an example of this system of concessions we may cite the condition of trades in the city of Vienna. About fifty years ago (the returns running from 1816 to 1821) we find:—

	Guildmasters.	Concessionists.
Hatters	75	47
Stocking-weavers	136	45
Rope-makers	13	20
Brush-binders	16	7
Coopers	81	40
Carriage-builders	48	27
Joiners	297	578
Turners	84	75
Furriers	58	13
Shoemakers	about 1400	about 1000
Glovers	32	81
Girdlers	30	22
Saddlers	69	61
Bookbinders	48	21
Tailors	1272	388
Carpet-makers	37	17
Umbrella-makers	9	17
Soap-boilers	35	10
Gold and silver workers	176	117
Tinmen	34	19
Tin-founders	12	5
Watchmakers	40	108
Clockmakers	80	24
Painters	35	21
Lacquerers	17	31

Thus in the above-named twenty-five handicrafts there were no fewer than 2,794 concessionists in comparison with 4,134 guildmasters, *i. e.* hardly sixty per cent. of independent tradesmen were members of guilds. Under such circumstances the guilds must have received a warning to reform their constitution in such a manner as to make the entrance into the guilds as easy and as advantageous as possible to those who joined. But history does not relate anything which shows any tendency towards such an end. The only thing they appear to have done was to combine one or two guilds the trades of which were connected, and even this was only done in places where the number of masters was too inconsiderable to form a guild of their own. And they further absurdly demanded that a master artizan who had shown himself worthy of mastership in one locality, should, on his settling in some new locality, demonstrate his capabilities afresh; or if a member, for instance, of the guild of smiths as a member of the united guilds of smiths and locksmiths, desired to go over to the branch of locksmiths only, he was required to demonstrate his capacity for the work by the production of another masterpiece.

In 1791 the whole system of guilds was abolished in France, and the most ample trade freedom declared. This soon had some effect in Germany, as that portion of Western Germany under French government, with its new political constitution, soon introduced the new commercial conditions. In Prussia this led to an entire revolution. The general control of handicrafts had been settled by conditions in 1794 still in force, when a sudden and total change took place, throwing all the trades open, in 1810; and the guilds previously existing, thus deprived of their privileges, lost all their former prestige. After many years' consultation this resulted in ordinances respecting mechanical trades, in the year 1845. The revolution of 1848, however, bore fruits of a retrogressive character in 1849, and the guilds were partially restored to their former privileges, while the journeymen were subjected to severer tests.

Similar retrogressions took place in the kingdom of Westphalia, on its dissolution. In Electoral Hesse the ordinance of 1816 was abrogated, and the freedom of mechanics was materially circumscribed. Those parts of the kingdom of Hanover in which this open trade existed, found a limit put to such endeavours until the events of 1847-8 brought about something moderately resembling the newly introduced state of things. In 1849 Nassau received an ordinance; and in Bremen another order in council gave some alleviation by which an entrance into the guilds was materially facilitated. In Bavaria a number of enactments (1807, 1825, 1834, 1853, and 1862) followed one after the other, but without the liberation of the mechanical arts. The old system was again restored in Würtemberg in the ordinances of 1828 and 1836, and in Baden it was wholly reintroduced by the edicts of 1807, 1808, and 1809. It was not until the year 1860 that any positively marked progress towards an emancipation of labour was made. Austria took the lead by its trade ordinance of 1859, by virtue of which absolute trade freedom began on the 1st May, 1860; this was followed in the same year by Nassau; in 1861 Oldenburg, Bremen and Hamburg took a similar position; the kingdom of Saxony, by a law passed in 1861, did the same thing; and we then find Würtemberg, Baden, Saxe-Weimar, Saxe-Meiningen, Waldeck, Saxe-Coburg-Gotha, Saxe-Altenburg and the younger house of Reuss. In 1864 Frankfort-on-the-Maine, and Schwarzburg-Rudolstadt followed, and in 1865 Brunswick (by virtue of an enactment of 1864), and at last in 1868 Bavaria, imitated the example of the

other states. Prussia, by its adherence to the common trade ordinances of North Germany passed in 1869, emancipated its handicraftsmen—and thus the bitter battle between the guilds and the extra workmen was fought out to the death. Thus we have new and well organized trade societies throughout Germany of character likely to promote the well being and raise the general tone of the handicraftsmen in all parts of that busy and enterprising empire.

With the sections of Professor Karmarsch's book relating to roads, canals, steamboat traffic, railways and telegraphs, we need scarcely concern ourselves here—inasmuch as those important subjects are so well known as to demand very brief comment in relation to the general history of technology. That improved means of intercommunication have materially added to the prosperity of the mechanical arts is a fact patent to all the world, and the employment of many hands in the more delicate portions of the work has been of material value. The history of patents, on the other hand, is worthy of our careful attention.

Patents appear to have taken their rise in the first instance in England, in the reign of James I. (1623-1624) by legislative enactment. For two hundred years, the general law of patents seems to have remained in a very undecided state, nothing of a systematic kind having been passed. No doubt that patents, however, arose from a modification of the monopoly system which, introduced during the reigns of her predecessors, was at its height under Elizabeth. Acts were, however, passed in 1835, 1840, 1844, and 1848, for the proper regulation of patent rights; these Acts, together with precedents arising out of judicial decisions, have since that time controlled matters in relation to inventions. The patent laws were, however, altered in 1852, and a general understanding arrived at. From 1617 to 1852, 14,359 patents were issued; and although many of the inventions thus protected have been found of very little value, still the remainder shows an extraordinary amount of industrial progress.

The new law of patents came into operation on the 30th September, 1852, and the following statement made up to 1869 will show, although few of these have been successfully carried out, that it gave enormous encouragement to inventors.

1852 (3 months)	1,211	1858 . .	3,007	1864 . .	3,260
1853	3,045	1859 . .	3,000	1865 . .	3,386
1854	2,764	1860 . .	3,196	1866 . .	3,453
1855	2,958	1861 . .	3,276	1867 . .	3,723
1856	3,106	1862 . .	3,490	1868 . .	3,991
1857	3,200	1863 . .	3,309	1869 . .	3,782

In France the nineteenth century was ushered in with legislative enactments about the patent laws, and the United States proceeded to pass Acts of Congress at almost the same time; in both countries these have received considerable modifications since that period. The laws in North America are respectively dated 10th April, 1790, the 21st February, 1793-1800, and 1832. An entirely new Act came into operation on the 4th July, 1836—amended by successive Acts in 1837, 1839, and 1842. The present patent laws in force throughout the Union date from the 4th March, 1861. America has far outstripped England in the number of its patents. From 1796 to 1828 patents to the number of 5,215 were issued—giving an average of 158 per annum. After the passing of the law of 1836, therefore between 1837 to 1848, the number was 6,251 (an average of 521 yearly) and in the following five years 1849-1833 there were 4,918 (an average of 984). From this time forward an enormous impetus was given to patents, as follows:—

1854 . . .	1,902	1859 . . .	4,538	1864 . . .	5,020
1855 . . .	2,024	1860 . . .	4,819	1865 . . .	6,616
1856 . . .	2,502	1861 . . .	3,340	1866 . . .	9,450
1857 . . .	2,910	1862 . . .	3,521	1867 . . .	13,015
1858 . . .	3,710	1863 . . .	4,170		

It may be readily understood that the decrease between 1861-1863 is to be attributed to the unfortunate civil war then raging between the Federal and Confederate States.

FRANCE.

The patent laws in France were fundamentally established by decrees of the National Assembly of the 7th January, and 25th May, 1791, and further settled by enactments in 1792, 1800, 1806, 1807 and 1810. Amendments and additions being left out of the account, this condition of the patent laws continued until 5th July, 1844, when a new system of legislation was introduced, under which patents are granted to the present time. In twenty-four years and a half from the 1st July, 1791, to the end of 1815, only 937 patents were granted, giving an average of 38 per annum. From 1816-20 there were 573 (average 115); 1821-1825 there were 845 (average 169); 1826-1835 there were 2,829 (average for ten years of 283); 1836-1843 there were 6,463 (average for 8 years 808); 1844-1851 there were 13,546 (average for 8 years 1,693); and in the following years the numbers stand thus:—

1852 . . .	2,855	1854 . . .	4,088	1856 . . .	4,400
1853 . . .	3,111	1855 . . .	4,128	1859 . . .	5,439

The additional certificates and renewals are not comprised in these statistics.

AUSTRIA.

The patent laws of this country take their commencement from the ordinances of the 16th January, 1810, but a more liberal patent law was enacted on the 8th December, 1820; to this succeeded a further law of 31st March, 1832 and finally the patent law of the empire was determined upon its present condition on the 15th August, 1852. During the six years 1815-1820 not more than 85 patents were granted, but from 1821-1832 there was a marked increase, 1,866 being issued; from 1833 to 1851 there were 4,572 (giving a yearly average of 241); from 1852 to 1855 there were 1,808 (average 452); 1856 to 1863 there were 5,037 (average 630); and from 1864 to 1870 there were 4,734 (the average being 676).

The extra Austrian German states are not in possession of any very definite patent laws, but have modified their patent rights according to circumstances. The German Customs Union (now a thing of the past) brought about some general understanding, but it seems ever to have been felt that the Customs Union was an arrangement of so entirely temporary a character that a proper consolidation of patent laws and rights is still a task to be accomplished within the limits of the new German Empire. The energy exhibited by the great German Chancellor and his colleagues will no doubt soon be exerted towards a proper and general law on this important question. It is, however, perhaps a singular circumstance, that Prussia has ever exhibited a curious apathy in relation to patents. Between the years 1815 and 1821 only 65 patents were granted, giving the very low yearly average of 9; between 1822 and 1837 there were only 272 (average 17); between 1833 and 1848 there were 648 (average of eleven years thus being 59); from 1849 to 1858 there were 691 (average 69); from 1859 to 1869 there were 762 (average 76); in 1869 there were 53, and in 1870 only 74. Perhaps this is owing to a strong conservative feeling among manufacturers in Prussia; very averse to trying new experiments, they have been remarkable for giving little stimulation to native genius in this particular direction.

In Saxony the system of patents was settled upon determinate principles by an ordinance of the 20th January, 1853; and when taken in comparison with its industrial prosperity it stands not unfavourably. From 1825 to 1838, therefore during fourteen years, only 31 patents were granted; from 1839 to 1845 there were 85 (yearly average 12); 1846-1851 there were 220 (yearly average 37); 1852-1855 there were 308 (yearly average 77); 1856 to 1867 there were 1,671 (yearly average 139); in 1868 there were 231 and in 1869 there were 190. The former kingdom of Hanover regulated its patent laws by a trade ordinance of the 1st August, 1847. From 1844 to 1854 there were 124 patents issued, and from 1855 to 1865 there were 498—giving an annual average of 45. Bavaria passed a trade law on the 11th September, 1825, supplemented by another ordinance of the 10th February, 1842; but the present state of things is settled by enactments of the 17th December, 1853, revised in 1862. The number of patents granted in 1842 was 47, and in 1843 it was 62, and during the nine years extending from 1844 to 1852 (both inclusive) there was a total of 884 (giving an annual average of 98); under the system of trial, since abandoned, the patents fell off between 1853 and 1861 to 370 (yearly average 41), but again increased, so that 92 patents were granted in 1862, 130 in 1867, and in the year 1870, the number was 108.

No patent law exists in Würtemberg except the trade ordinance of the 22nd April, 1828 (revised the 5th August, 1836). There were only 85 patents applied for between 1849 and 1853 (giving an annual average of 17), during the following six years, 1854 to 1859, there were 250 (annual average 42); between 1860 and 1865, the number rose to 498 (giving a yearly average of 83), in 1866 there were 66, in 1867, 140, and in 1868 there were 139 patents. In the Grand Duchy of Baden we have to mention 39 patents as granted between 1852 and 1855 (average about 10), while the succeeding seven years 1856 to 1862 show 213 (giving an average for each year of 30 to 31). The Grand Duchy of Hesse only shows 215 patents granted during thirty-six years from 1827 to 1862; for a period of six years not a single patent was applied for, and between 1855 and 1862 the total was only 109, giving an average of some 13 per annum.

Very closely allied to the patent law is that body of enactments dealing with the protection of designs and patterns, these include designs in weaving, carpets, and stuffs, or specially useful or ornamental patterns of jewelry and all kinds of utensils.

As the patent laws contemplate only protection for positive novelties in principle, or adaptations of well-known inventions, there is an unfilled void in legislative enactments here, which it has been sought to fill by so-called pattern protection laws ("Musterschutzgesetze"). Patterns, however important in themselves, occupy a lower industrial rank than inventions, and therefore can scarcely expect to obtain such wide protection. Hence the time for which they are protected is ordinarily much shorter, and the penalties of infringement are considerably less. If it be remembered, also, that such importance as they possess has been recognized much more recently, it is easy to understand why this should be so. France and England led the way in legislation upon this subject. The silk factories of Lyons were protected in their patterns and designs by statute since 1737 and 1744, and in 1787 a similar law ensured to all manufacturers through France the property in their designs. The present law is based upon the decrees of 19th July, 1793, revised by a further enactment of the 18th March, 1806, and certain penalties were introduced into the penal code of 1810, while an ordinance of the 29th August, 1825, further facilitated the protection of patterns. Belgium possesses a similar law, by royal ordinance of the 9th of April, 1842.

In England a law concerning patterns was first passed in 1787, confirmed in 1789, amended in 1794, and extended in 1798. Other improvements were introduced in 1814, but the present principles of protection depend upon an Act passed in 1839, perfected by further emendations in 1842, 1843, and 1850.

The United States passed an Act of Congress on this point in 1842, but this has been repealed by a further Act concerning patents in 1861, and at present both inventions and designs are protected by one Act, hence accounting for the increase in the number of patents noted above.

Austria passed a law coming into force on the 1st of March, 1859, on this subject; but the rest of Germany has as yet done little to protect designs, the Prussian Rhine provinces being under the French law. Russia has, however, possessed a law protecting designs since the 11th of July, 1864.

The principle of association which has done so much to expand the interests of society, has not failed to be applied in matters of a technological character. For this purpose societies have been established throughout the world, having among their objects the following main intentions:—1. The collection and publication of facts connected with the condition of trade and industry throughout the districts represented by each society; 2. The amendment of ascertained evils; 3. The fostering of a spirit of invention and investigation among the industrial class; 4. The encouragement of scientific instruction throughout all technical trades; 5. The further encouragement of an intimate acquaintance with the most important improvements of technical processes in foreign countries and their introduction at home; 6. Control over commercial law and police; and, 7. Material support and assistance to such branches of industry as may be in a languishing condition from extraneous or inherent causes.

The accomplishment of these various objects has been effected by a system of machinery differing in detail but agreeing in the main. Thus meetings are held with lectures and papers of a scientific or technical character, periodicals of a specially trade character are issued, schools are maintained, industrial exhibitions are held, money premiums and distinctions of an honorary kind are held out as inducements, and other means of a stimulating and fostering nature have been introduced. Of course such societies may be international, patriotic, or local in their constitution, and each within its own sphere is calculated to exercise a favourable effect upon the general progress of technological science.

The oldest national institution of this kind in the world exists in England, the Society for the Encouragement of Arts, Manufactures, and Commerce, founded 1754, and commonly called the Society of Arts, in the Adelphi. This admirable society, as is well known, comprises amongst its members, the highest, most distinguished, most learned, and most intelligent minds of England. On its services to technology and to science in general it is quite superfluous to enlarge here. The active Institution of Civil Engineers was founded with similar objects, but of a more circumscribed character, in 1818. In France, the "Société d'Encouragement pour l'Industrie nationale" fulfils the same duties as the London Society of Arts; it was founded in 1801. The "Société industrielle" at Mülhausen in Alsace (founded 1827) may now be considered a German institution since the restitution of Alsace and Lorraine to Germany.

Germany began to form an association for trade purposes as long since as 1765, but the best efforts of that country are very modern. Bavaria led the way with the Royal Polytechnic Association, 1815 ("Polytechnisches Verein") at Munich; then followed the Association for the Encouragement of Trade Industry ("Verein zur Beförderung des Gewerbfleisses") in Prussia, at Berlin; the Commercial and Trade Association ("Handels- und Gewerbverein") for Electoral Hesse, at Kassel (1821); in Saxony there existed an industrial institution at Chemnitz in 1830, but it lapsed after some ten years; at Stuttgart in 1830, the Society for the Encouragement of Trades, ("Gesellschaft für Beförderung der Gewerbe") in Würtemberg was instituted, the directing body of which ultimately became a state department in 1848 under the name of Central Office for Trade and Commerce, and in this sense was subsequently modified in 1855; in 1833 the Bohemian Institution for the Encouragement of Trade ("Verein zur Ermunterung des Gewerbsgeistes) was started at Prague; in 1834 a similar association was inaugurated at Hanover for the kingdom of Hanover; in 1836 followed the Trade Association at Darmstadt in the Grand Duchy of Hesse; the Duchy of Brunswick succeeded with a similar society at Brunswick in 1838; Austria proper also set on foot in the same year an Industrial Association at Graz; the Lower Austrian Trades Union, having its seat at Vienna, was opened in 1839, and in 1840 the Oldenburg association was established, as well as the association for the Duchy of Nassau at Wiesbaden in 1845.

The following list of other industrial institutes deserves mention here, as a proof of the real practical character of the German nation, and so as a vindication of the Teutonic element, so long deemed vague and dreamy by its opponents. Nothing is more conservative than trade in its real effect upon society; and as these lines are written while a great political and social struggle is progressing here in England, nothing can be better evidence of the truth that social improvements and commercial interests may be advanced, although to some extent there may be an apparent reaction towards modes of thoughts and manners of expressing them, foreign to our modern hurried ways of thinking. Calmer thinkers may not be indisposed to regard the modern revivification of the German empire as a real earnest of the true future of a great and thoughtful body of our fellow-labourers in the cause of human economics.

Prussia (before 1866).

Erfurt (Trade Association)	1827
Breslau (Trade Association)	1828
Elbing (Trade Association)	1828
Sagan (Trade Association)	1829
Köln (Cologne) (Polytechnic Institute)	1830
Königsberg (Art and Trade Association)	1832
Koblenz (Trade Association)	1835
Aachen (Society for Useful Sciences and Trades)	1836
Düsseldorf (Trade Association)	1836
Potsdam (Trade Association)	1843
Berlin (Polytechnic Society and Mechanics' Association)	1844
Magdeburg (Trade Association)	1845
Insterburg (Trade Association)	1846
Halberstadt (Trade Association)	1847
Stettin (Polytechnic Society)	1862
Essen on the Ruhr (Trade Association)	1865

Hanover (late Kingdom of).

Local Trade Association of the City of Hanover	1835

Saxony.

Leipzig (Polytechnic Society)	1825
Annaberg (Trade Association)	1828
Chemnitz (Mechanics' Society)	1829
Bautzen (Trade Association)	1833
Dresden (Trade Association)	1834
Zittau (Trade Association)	1835
Freiberg (Trade Association)	1845
Zwickau (Trade Association)	1846

Thuringian States.

Altenburg (Art and Mechanics' Association)	1818
Coburg (Art, Industrial and Trade Association)	1825
Weimar (Trade Association)	1833
Saalfeld (Thuringian Art and Trade Association)	1836

Mecklenburg-Rostock.

Trade Association	1834

Hamburg.

The Hamburg Society for the Encouragement of the Arts and Useful Trades. (Formerly alluded to as founded in 1765, reorganized in 1832.)	

Bavaria.

Würzburg (Polytechnic Association)	1806
Fürth (Industrial and Trade Association)	1843
Bamberg (Trade Association)	1844

Baden.

Karlsruhe (Trade Association)	1831
Lahr (Trade Association)	1836
Mannheim (Trade Association)	1842

Grand Duchy of Hesse.

Mainz (Association for the Encouragement of Trades)	1839

Frankfort-on-Maine.

Frankfort Society for the Advancement of the Useful Arts and their Allied Sciences, founded 1816, with a branch for the special promotion of trade interests in 1835.

The above list will sufficiently show how alive the various trades or commercial activities have been to their own interests in philosophic Germany, even during a period in which their best powers were lamed by political and social calamities. The list is, as may be supposed, by no means complete, but it furnishes a sufficient idea of what may be anticipated from that long paralyzed land. It is the fashion in England to depreciate foreign labour, to argue that when it works at "shorter" rates than English labour in this country—then for that reason English mechanics should rebel and turn out their foreign competitors; but surely the writer may be allowed to say that it is nowhere written, even in the most intolerant of codes, that men may not employ themselves at any lower rate of wages they please—that they may not spend their earnings or save them according to their individual tastes and pleasure. The English mechanic may decline to work for less than a certain sum; but the employer, who must get his work done, is surely entitled to seek aid from whomsoever he pleases, and the doctrines blindly preached by the Working Men's Trades' Unions will never be successful in the face of individual liberty of hiring. It is quite another matter whether the quality of the cheaper work warrants a return to higher rates. So long as men must eat, they have a right to sell their individual labour for what they can get, and no body of men can rightfully interpose and say if you cannot obtain so or so much, you must hold your hands and starve. Were this an accepted doctrine, the money capital representing the accumulation of former labour, would sink in value, become useless, and the labour in the market would be lost, to the disadvantage of the man of mechanical skill, or bodily thews and sinews.

Let us, however, turn to another aspect of this great battle between capital and labour, so composite and so incoherent in its nature. It matters not to the present generation in what manner the capital at command for industrial purposes has been accumulated in past ages—whether it be the result of rapine, or the proceeds of rightly applied industry, the capital is there, and the labourers of our day depend upon its employment for their subsistence during the time they are able to work, and for a provision for the time when they are past work. An unnecessarily high rate of wages has been found to engender luxury, and in like manner unwontedly low wages impair the value of the labourer. For the value of a labourer at a given age, say twenty-five, has been computed to represent a certain amount of money—fluctuating between short limits, according to the market—the sum being about £238 in all. If wages are so low as to destroy the ability to labour, that amount of capital is therefore imperilled or may be lost—and if wages, on the other hand, are too high, the unthinking mechanic may destroy the capital he represents in himself by excesses, intemperance, and other evils to which the lower stratum of society is peculiarly prone, and for which there exist only too many temptations. In newly populated countries where labour is valuable, the capitalist and labourer are often united in the same individual, as in Australia, Brazil, or the backwoods of America. A capitalist can no more live by his capital—save by depreciating and wasting it when it is unemployed, than a labourer can live by idleness. Interest is the usufruct of capital, and employment the usufruct of labour. Capital without interest remains unproductive, and the leaders of strikes have thought to destroy capital, or at any rate to control it, by depriving it of its natural aliment—interest. Capital therefore protects itself by shutting itself up, and labour is annihilated. Capital insufficiently aided by labour will waste, and labour inadequately aiding capital contributes towards its own extinction. If there be no one to give employment, who can be expected to be employed? and the tide of emigration flowing from this country by no means leaves the market so empty as to preclude the employment of foreign labour at lower rates. Intelligent mechanics are continually returning from the United States, the colonies, and other countries, with wofully long faces and sad reports of the condition of labour in those lands where the apparently higher rate of wage had seemed to promise them a speedier independence with less effort and more temporary comfort.

Sir Joseph Whitworth, either consciously or unconsciously, has been recently imitating a principle long since practically applied in France and Germany. In some of the very large manufactories of France, the men are allowed to participate in the earnings of the firm—a per-centage is paid them in the nature of a bonus on the year's profits, and great advantages have been offered the operatives by the institution of saving's banks. Sir Joseph Whitworth has very generously joined in a movement of the greatest importance to the general body of mechanics and operatives, but he is by no means the first to introduce it. There can be no doubt that a general movement in this direction on the part of masters will tend more towards doing away with dissatisfaction than any other method at present in use. Show the working man that it is his interest to save, and he will no doubt avail himself of whatever may be held out to him; we should then hear less of workmen's strikes, and more of unanimity between employers and employed. We should see less of "scamped" work and more of promotion, more of generous and friendly emulation among workmen, while the ideas existing on the inter-relation of capital and labour would become more exact and properly understood. That the captain of labour, backed by his capital, has more responsibility than the workman is self-evident, but it is not all captains of labour who, like Sir J. Whitworth, think it worth while (even applying the words commercially) to take care of the rank and file in this way.

The introduction of provident associations in Germany is due to Samuel Gottlieb Liedtke (born 1803 at Rautenburg in East Prussia, died at Berlin in 1852 as accountant-general); and similar institutions for provision against dearth, and, in winter, coals and clothes, have since abounded in that country, as in almost every other,—the principle, in fact, of our friendly societies being the basis of them all, and as it is so widely understood it scarcely need be dwelt upon here. Loan and credit societies were also instituted in Germany, being first proposed in 1849 by Herman Schulze; these latter societies are intended to aid small masters in the completion of work and in other ways. Schulze also established raw material societies, *i. e.*, societies for the purchase of large quantities of material for use among the trades of some particular place; as, for instance, at Delitzsch near Leipzig in 1849, when he induced the shoemakers of that place to join together in buying leather wholesale. This society consisted at first of fifty-six members, but in 1859 it numbered ninety-four members. It was the first of its kind, but the principle has been adopted in many other places since that time. Carpenters, weavers, bookbinders, tailors, &c., have since combined in a similar manner.

Everyone acquainted with the history of trade in this country, is aware of the noble story of the Rochdale co-operative stores, the tale of which has been eloquently and concisely told by Mr. J. G. Holyoake; it was not likely that an experiment at once so bold and unassuming should not have been imitated abroad. Labour bazaars have also become not unfrequent on the continent, where an entire business has been successfully carried on upon the joint-stock principle. In 1864, 183 such societies existed in Germany; in 1865, there were 199; in 1866, 187; in 1867, 196.

It is scarcely necessary to enter very largely here upon the history of trade exhibitions and museums; it is enough to state that no European country is without such institutions, and there is no question that the principle upon which they have been established has taken such firm root that they are never likely to fall into disrepute. Paris has its *Conservatoire des Arts et Métiers*, Brussels its *Musée de l'Industrie*, Würtemberg its *Musterlager* (Depot of Designs), London its South Kensington Museum and allied institutions, Vienna its Museum of Art and Industry, Lyons a similar museum, Baden its National Trade Hall, Berlin its German Trade Museum, Moscow its Museum of Arts and Industry, Bavaria, at Nürnberg, an Art and Trade Museum, and Cologne possesses the Rhine and Westphalian Museum for Art and Industry. Other institutions of an analogous nature flourish at Hanover, Frankfort-on-Maine, Chemnitz, Weimar, Görlitz, and many other places.

While such museums are very useful as recording that which has been accomplished in the industrial arts, of course they cannot serve the purpose of instructing the students of technology in the progress of the various branches of manufacture. Hence it has been found necessary and highly successful to inaugurate periodical trade and industrial exhibitions,—some of a purely local character and some national or universal in the best sense. France first led the way in this development of commercial and industrial enterprise, in the year 1798, from the 19th of September to the 2nd of October, with only 110 exhibitors. The following list gives the years in which other exhibitions followed in quick succession :—

1801	with	220 exhibitors	1827	with	1795 exhibitors
1802	„	540 „	1834	„	2447 „
1806	„	1422 „	1839	„	3381 „
1819	„	1662 „	1844	„	3960 „
1823	„	1642 „	1849	„	4494 „

Between the years 1803 and 1866 there have been no less than 53 provincial and special exhibitions in 25 French cities and towns.

In the year 1820 a series of exhibitions were opened in Austria—at Prague, Brunn, Graz, Klagenfurt, Laibach, and other places; but the first national exhibition for the whole empire was held at Vienna in 1835, with 594 exhibitors; again in 1839, with 732 exhibitors; and 1845, 1865 exhibitors. Prussia had two national exhibitions at Berlin in 1822, with only 176 exhibitors; and 1827, with 208 exhibitors; and a National German Exhibition in 1844. Since 1830 provincial exhibitions have frequently taken place at Königsberg, Görlitz, Breslau, Magdeburg, Herschberg, Coblenz, Düsseldorf, Halberstadt, Cologne, Aachen, Liegnitz, Grüneberg, Berlin, Erfurt, Bunzlau, Oels, Warmbrunn, and elsewhere.

National exhibitions in the kingdom of Saxony first commenced in 1824, and were afterwards repeated with increasing success as follows:—1831, with 169 exhibitors; 1834, with 286 exhibitors; 1837, with 364 exhibitors; 1840, with 323 exhibitors; and 1845, with 683 exhibitors. Six national exhibitions were held in the former kingdom of Hanover in the following years:—1835, with 381 exhibitors; 1837, with 385 exhibitors; 1840, with 258 exhibitors; 1844, with 348 exhibitors; 1850, with 255 exhibitors; and 1859, with 296 exhibitors. Electoral Hesse had its first national exhibition in 1817 at Cassel, and several others succeeded it.

The attempts made in 1818 and 1819 in Bavaria, at Munich, were very discouraging, as were also the exhibitions of 1821, 1822, 1823, and 1827; but the Munich exhibition of 1834 had 779 exhibitors, and 1835 had 944, while the Nürnberg exhibition of 1840 had 1001 exhibitors. Similar national exhibitions were held in Würtemberg, the Grand Duchy of Baden, the Grand Duchy of Hesse, and the Duchy of Nassau. This last had an extraordinary number of exhibitors for the extent of the territory, the exhibition of 1863 at Wiesbaden numbering no less than 1,317 exhibitors. It will, however, have been seen from these statistics that however varying the success of these exhibitions the principle had found great favour throughout Germany, and was likely to have greater extension in the future. The first really national exhibition worthy of the name was held at Mainz in September, 1842, with 715 exhibitors—222 of these being natives of the Grand Duchy of Hesse and the remainder from 20 different German States. This, however, led to another experiment on a much larger scale at Berlin, under the patronage of the Prussian Government, where a German National Exhibition was held in 1844, comprising 3,040 exhibitors—1,932 from Prussia, 859 from the Zollverein states, 174 from other German states not comprehended in the Customs Confederation, and 75 from Austria. The Saxon Government opened a similar exhibition at the Easter fair in Leipzig in 1850, comprising 1,494 exhibitors. In 1854 there was an exhibition with 7,005 exhibitors at Munich; and this, with the exception of the Vienna exhibition of last year, was the most considerable held in Germany.

Switzerland had exhibitions: in Lausanne, 1839; Berne, 1843, 1846, 1848, 1857, 2,050 exhibitors; St. Gall, 1843; and Zürich, 1847, with 242 exhibitors. The Netherlands had exhibitions at Ghent, 1820; Tournay, 1824; Haarlem, 1825; Brussels, 1830; Arnheim, 1868. Since the establishment of the kingdom of Belgium the exhibitions have been at Brussels, 1835, 1841, 1847, 1848, 1856; at Ghent, 1849. Sweden has frequently tried national exhibitions at Stockholm but with very slight success—1823, 62 exhibitors; 1834, 290 exhibitors; 1840, 200 exhibitors; 1844, 210 exhibitors; but a very successful Scandinavian Exhibition (comprehending Norway, Denmark, and Finland) was held at Stockholm in 1866, comprising 4,175 exhibitors. A Norwegian exhibition was held in 1854 at Christiania. Russia had exhibitions for the whole empire at St. Petersburgh, 1829, 324 exhibitors, 1833, 1839, 1849, 1860, and 1870; at Moscow, 1831, and 1835; and at Warsaw, 1841 and 1845.

Of Italian exhibitions the most important were those of the Kingdom of Sardinia of 1829, 1832, 1838, 1844, 1850, 1854, and 1858, and those of the Grand Duchy of Tuscany at Florence in 1844, 1850, 1854, and 1861. Of Spanish exhibitions we should name those at Madrid, for the entire kingdom, of 1827, 1828, 1831, 1841, 1845, 1850, and 1854. Two exhibitions took place in Portugal at Lisbon in 1844 and 1849. Greece, together with her revived Olympic games, had an exhibition at Athens in 1859, with 947 exhibitors. Even the Turkish Government had an exhibition at Constantinople in 1863, comprising the natural and industrial objects of the empire; and a Roumanian exhibition was held at Bucharest in 1868.

Exhibitions have also been held in the United States, at New York, in 1828, 1849, and 1858; at Washington in 1846, at Philadelphia in 1865, besides the International Exhibition at New York of 1853. The Empire of Brazil had an exhibition of raw products at Rio de Janeiro in 1866, comprehending 2,374 exhibitors, and the Australian colony of Victoria had one in 1861, with 183 participators, comprising for the most part natural products and raw materials.

It will have been observed that no mention has hitherto been made of the Great Exhibition of 1851, probably in itself the most unique exhibition in the world. Its history is so well known as to need no record here; but no one who saw it can ever forget the impression made on the mind by the Fairy Palace in Hyde Park. The writer travelled nearly two thousand miles to see it, and only was able to visit it thrice. The number of exhibitors was officially given at 17,062; of these, 7,200 were from the United Kingdom, 1,296 from the British Colonies and possessions, 1,720 from Germany, 748 from Austria, 1,828 from France, 4,270 from other countries. The grand success of this great experiment was to produce numerous imitations all over the world, and we are glad to find that Dr. Karmarsch, in speaking of these imitations, holds the very reasonable view that their frequency has materially interfered with the real interests of industrial science. The Dublin Exhibition (mainly owing to the liberality of Mr. Wm. Dargan, since deceased), opened in 1853 was a failure, and the New York International of the same year was a very pinchbeck piece of business, altogether unsatisfactory to all persons who took part in it.

The Paris Exhibition of 1855 was, however, on a grand scale, and although the effects have not been permanent, the sight was most attractive. Here, too, an Art Exhibition of all Nations lent its aid to educate the masses and amuse the general visitors. The number of entries as exhibitors was 21,921, of which France and her colonies contributed 11,050, Germany 2,268, Austria 1,371, and the British Empire 2,849.

The next London Exhibition was in the year 1862, on an enormous scale. Perhaps the art galleries erected on this occasion were the most suitable ever erected so large, but they were doomed to fall before an adverse vote of the House of Commons, and finally, after the materials had stood glittering in the sun for years at Muswell Hill, as the Alexandra Palace, amidst financial difficulties innumerable, a plumber's kettle boiled over, and, like other stately edifices, fire swallowed it up.

In 1865 there were three exhibitions of an international character, one at Dublin, one at Oporto in Portugal (3,911 exhibitors), and one at Stettin in Germany (1,451 exhibitors). These exhibitions proved by their financial failure the truth that cities remote from the centres of industrial and national activity are by no means fitted for such general gatherings; while, on the other hand, Paris in 1867 gave a brilliant proof of the adaptability of that great continental centre for the purpose. On this occasion no less than 42,217 exhibitors thronged to Paris, and for a time rendered that city a temple of the industrial sciences. Dr. Karmarsch observes (writing before the recent Exhibition at Vienna in 1873) that it is probable future exhibitions will never attain the same success, and, as far as financial matters go, Vienna has justified his prediction. Bringing this section to a close, we have only to observe that in 1869 and 1870 three more International Exhibitions were opened at Amsterdam, Altona, and Cassel; none of these, however, either in importance or popularity, approached the original conception of 1851. Of course we have now a permanent Annual International Exhibition at South Kensington; but it is impossible to disguise the fact that it has not any very great importance, so far as the interests of engineers, manufacturers, or other great patrons of industrial science are concerned.

We need not in this article enter upon several subjects upon which Dr. Karmarsch treats at some length under different headings, such as the constitution of the German Customs Union or Zollverein, the unification of coinage, measures, and weights, and the minor questions dependent upon such a change. It is plain that any definite international legislation on these points is yet very far off, and of little importance to technologists at the present day. The confusion of measures of length, capacity, &c., is still extraordinary, as may be seen from a German official statement we will quote, and which is as recent as 1861.

"We have," says this report, p. 188, "at least thirty different and perfectly legal measures of length denominated feet, the magnitude of which varies from 250 millimetres to 316 millimetres. In some places the foot is divided into 12 inches, in others into 10; the inch consists here of 12 lines and there of 10, and in other places is divided into eight parts. The ell is frequently equal to 2 feet, but in other parts it is equal to 1·96316—1·98262—$2\frac{1}{8}$—2·144—2, 4—2,465—$2\frac{4}{11}$th of a foot. The fathom (*Klafter*) contains 6 or 10 ft., the rod (field measure) in differ-

ent localities varies from 10, 12, 12½, 14, 15½, 16, 18 and 20 ft. Superficial land measures appear as acres (*Morgen*) of 2,025 to 9,657¾ square metres; acres (*Acker*) of 2,270 to 6,443 square metres, or yokes (*Joch*, *Juck*, and *Jück*) of 4,538½ to 5,755¾ square metres. A cord of fuel in every state is of a different size, and often in the same state it may have two or three different capacities, the contents varying between some 2¼ and 5¼ cubic metres. Of liquid measures we have buckets (*Eimer*) of from 29 to 294 litres contents; ankers of from 34 to 39 litres. The *Eimer* is divided into 40, 60, 72, 80, or 160 measures, then again into 32 quarters, or into 60 quarts, or into 36, 40, 60, 72 cans. The measure (*Maass*) varies between half a litre and 2 litres; the quart or quarter between 0·805 and 1·145 litre; the can varies from 0·921 to 1·82 litre. The legal pint (*Schoppen*) contains 0·375—0·398—0·448—0·459—0·487—0·5 litre. In corn measure we find all sorts of bushels (*Scheffel*), the smallest containing 22·8 litres, and the largest 222·36 litres; combs or curnocks (*Malter*) of 100 to 1,246 litres; *Himten* of from 27½ to 40⅕ litres; *Simmers* equal to 12½ to 110½ litres; pecks (*Metzen*) from 1·95 litre to 61·5 litres." In Hanover two different ells are in use, seven measures of capacity, and some twenty superficial measures, while similar absurdly perplexing variations are to be encountered at almost every step. Even the metrical system of France, the philosophical truth of which has long ceased to be held in respect, is at any rate better than this confusion. To consolidate and rectify this hopeless system is another of the commercial duties of the new empire, and no doubt it should claim early attention at the hands of experts and the legislative body.

The history of the literature of any science is often, if not always, as important as the science itself, inasmuch as it is only by a good knowledge of the theoretical portions of a science that new ideas can be promulgated and ultimately carried into practice. We may therefore give a brief account of the history of technology as a science, especially as concerns the Continent.

Although we cannot as yet celebrate the centenary of technology (or the doctrine of the transformation of raw natural products into objects of physical use), in a scientific sense, it has become of sufficient importance to take no mean rank among the sciences hitherto accepted. Its history may be divided into three periods, each of which we shall now proceed to consider. The first attempts to systematize the rude materials of the science like those made in other sciences are to be found in the stupendous cyclopædical works of the latter half of the middle ages. Indeed it is singular to observe how the quaintest conceits connected with speculations of the most unpractical nature were in those days mingled with shrewd suggestions of the utmost interest to the historian of the inner life of the people. Of this, quite apart from previous works, the recondite collections in the commonplace books of Robert Southey form an admirable and easily accessible instance. That patient and omnilegent reader and student conceived the idea of writing a life of the people with their every-day wants and habits, and left behind him in those volumes very curious pickings, as we may call them, from the rare and recondite works of older writers, abandoned for the most part to the dusty recesses of our public libraries. Mr. Buckle, in his "History of Civilization," to a great extent realized the idea formed by Southey; but the lamented death of Buckle, at a very early period of his life, prevented the completion of his design. Mixed up, therefore, in this curious way we find the first glimpses of technical processes somewhat after the style of old receipt books, where the rudiments of some chemical preparation, now affording profitable employment to thousands, are succeeded by a magical mode of catching thieves by a talisman, or a magical way of telling a girl who her husband was to be. Of this nature was Baptista Porta's "Natural Magic," and the works of Cardan are full of similar occult and ludicrous prescriptions. Another work mentioned by Dr. Karmarsch is the "Piazza Universale di tutte le Professioni del Mondo," published by the ecclesiastic Tommaso Garzoni at Venice in 1585, and which afterwards appeared in a German dress at Frankfort-on-Maine in 1659, under the title of "Universal Theatre, Market, and Convention of all Professions, Arts, Businesses, Trades, and Handicrafts." The author mentions in the introduction no less than eleven hundred and four authors from whom he had gathered the materials, the matter of which is miscellaneous enough in all conscience. In 153 chapters (called discourses) we find all sorts of things treated, viz. every kind of smith's work, pottery, distilling, goldsmithery, flax and hemp spinning, button making, dyeing, glass making, and so forth; but inextricably confused with lordships, regents and tyrants, ecclesiastics, lawyers, almanack makers, astrologers, notaries, cabalists, authors, magicians, and witches, interspersed with observations not seldom displaying much humour or sharp criticism. This book is a good example of the early works on scientific subjects, and is one of the earliest treating in any way of matters of technical interest. The first half of the eighteenth century already had some well-meant monographs on commercial questions to show, such as the "Description of the Hatmaker's Trade," by the Councillor Marperger (Altenburg, 1719), and "Perfect and Fundamental Account of Gold and Silver Wire Drawing, &c.," by an unknown author, who gives the pseudonym "Lejusugo" (Lübeck, 1744). The first work is an octavo of some 160 pages, but only devotes 27 pages to the technicalities of hat making, the rest of the work being devoted to the consideration of the origin, form, custom, and use of hats; of the hats of electoral princes and dukes, of cardinal's hats, of the statutes, customs, and rights of the hat makers, and such other weighty and serious topics. The second treatise is somewhat technical in its treatment (speaking of the melting, sublimation, and separation of silver, of gilding, wire drawing, plating, &c.), but it everywhere presupposes a practical acquaintance with the business, and therefore can only be regarded as a work of advice for more advanced artizans. As Dr. Karmarsch very properly says at p. 861—"All these and similar contributions in no way founded any idea of a technological literature, far less did it give any warning of the future rise of a technological science." Similar works (as, for example, the work by Plumier on the "Art of Turning," Paris, 1749), issued from time to time from the presses of Europe, but aided little in the general establishment of technology.

René Antoine Ferchault de Réaumur (the inventor of the thermometer so named, born at La Rochelle in 1683, died 1757 at Bermondière in Maine), was the first person to suggest the publication of a series of accurate descriptive treatises on technical subjects, and the Paris Academy of Sciences in 1761 accordingly commenced such a series of works with ample illustrations. These works occupied more than twenty years in publication, and did not fail to draw the attention of the scientific and mechanical world. For the most part these books deserve the reputation they gained; and Germany, possessing no wealthy academy and but slight pecuniary means to support such an undertaking, nevertheless ventured to present the work in a German dress to the German public, and it eventually appeared under the title of "Schauplatz der Künste und Handwerke" (Theatre of the Arts and Handicrafts), in twenty-one volumes, between the years 1762 and 1805, a period of more than forty years. It is sufficiently indicative of the spirit in which they were received to note the long interval between the first and the last volume, nor were any very great improvements attempted in the translation, which therefore abounds with antiquated methods and processes. The concluding volume was the only original portion of the work, nor was this in any degree of marked value. Some attempts made at this time deserve mention, although the desirable accuracy was not attained and perhaps not attainable. We may among these mention the "Werkstätte der heutigen Künste oder die neuere Kunsthistorie" (Workshops of the Arts of the Present Day or Modern Art History), by Professor Johann Samuel Halle, in Berlin (6 volumes, 1761-1779). The most important work, however, was that of Peter Nathanael Sprengel, "Handwerke und Künste in Tabellen" (Trades and Arts in Tables), continued by Otto Ludwig Hartwig (17 parts, Berlin, 1767-1795), a work possessing at least the merit of having been based upon practical experience and close observation. Considering the age at which it was produced and the contemporary circumstances attendant upon its publication, it deserves respect at the hands of the critic. It comprehends about one hundred of the trades then practised in Prussia, and it is everywhere clear and practical in style. The words "in Tabellen" are liable to misconstruction; but the meaning is that a very precise division and subdivision with headings is observed throughout the work. A more limited work is that of Jacobsson on matters connected with weaving ("Schauplatz der Zeugmanufakturen in Deutschland," Theatre of Stuff Manufacturers in Germany, 4 vols., Berlin, 1773-1776); the same author published a "Technological Dictionary" in four volumes (1781-1784), comprehending the latest knowledge of that time, which was afterwards supplemented by other four volumes by G. E. Rosenthal (1793-1795). Christian Leberecht Rösling projected an ambitious undertaking (Fabrikenschule, 1806-1808), but this was discontinued at the third volume after potash, nitre, and other similar substances, had been described and their manufacture treated. The first period of the literary history of technology may be closed by a mention of Diderot and D'Alembert's "Encylopédie" (1751-1780), and the "Encyclopédie Méthodique" (116 volumes of text and 51 volumes plates), (1781-1832), by various French authors, and the "Economico-technological Encyclopædia" ("Oekonomisch-technologische Encyclopädie," 242 vols. 1782-1858), begun by Krünitz and since that time continued by several others. These works, reaching down to the present time, in certain divisions

contain information of the most extensive and circumstantial nature.

Perhaps the second period is best defined as the period of chamber study—when special manuals for individual students began to be prepared. The most prominent of the writers of this kind, and at the same time the one best known to the English reader, is Johann Beckmann, Professor of Economics at Göttingen (born at Hoya, 1739, and deceased at Göttingen in 1811). He was the first writer who made use of the word technology as applied to the history of the mechanical arts—hence he is to be regarded as the father of the science in its modern acceptation. His contributions to Economics and Technology were published between 1777 and 1790, and his history of inventions from 1784 to 1805. A popular translation of the latter work is easily accessible at a very moderate price. Beckmann's "Introduction to Technology" reached its fifth edition in 1809, and was pirated besides. The author in this work observes that he had no idea of forming practical mechanics by its means; but he maintained in strong terms the great utility of technological information to non-practical persons. His work, however, was very limited in its aims, both from the circumstance that it was delivered as lectures, and from the industrial scope of Göttingen itself. His work comprehends only a very small number of trades—these in general being connected with chemistry—the actual mechanical arts mentioned by him being the wool manufacture, stocking weaving, hat making, paper making, oil production, the tobacco trade, needlemaking and coining. These he describes in very brief terms, and without reference to technical particulars, evidently reserved by him for immediate communication. There is no trace of a scientific treatment of the whole subject—no plan in the arrangement of parts, or of comparison and criticism. All is of a descriptive character, and even where regarded from this point of view, it is jejune and unsatisfactory; occasionally some historical details are given with a view, as he says, "to strew a few flowers over the monotonous character of his discourse." Yet the book was welcome, as it opened a new field for the statement of unquestionable deficiencies. In his Essay towards a general plan of Technology, published in 1806, he came nearer to the spirit of the science—although what he put forth was inconsiderable in extent. An idea had in this treatise been born into life, only requiring necessary development to awaken manifold interests and do a great amount of good. This idea was that the branches of industry ought not to be classified according to the outer requirements of social life, but according to their inherent interrelations as branches of a common scientific study. Beckmann, from this point of view, arranged such interrelations under fifty-one heads, leaving it, however, to others to carry the programme out, with such modifications as might appear necessary.

We may thus see that technology proper would now fall under various heads, such as *special technology*, having reference to one particular art or manufacture, and *general technology*, perhaps better still designed *comparative technology*. Special technology then would have for its proper sphere of inquiry, the transformation of any given raw material into any given industrial product, together with all the processes demanded for the accomplishment of this end; hence it should occupy itself with means, appliances and machinery necessary in each instance, explaining their uses and the conditions into which the original substance is brought from its first condition to the processes until its conversion into the product required. From it we ought to obtain an actual picture of what is done from first to last. Whereas general or comparative technology is chiefly occupied with the similar processes applied to substances of the most diverse character, according to similarities of state at various stages of manufacture.

This would necessarily immediately endow technology with a truly scientific character, far removed from the mere empirical methods applied in various trades without any coherent interests. It gives an impetus to inventions for some specific purpose of economy, such as the introduction of tools and machinery alike applicable to raw materials of the most heterogeneous character, and effects a corresponding economy of effort.

But this indication afforded by Beckmann, which was likely to open a new world full of practical treasures, was at first altogether neglected. It was easier to pursue the pristine pedantic path, offering to the world nothing better than descriptive accounts of the various processes of trades, according to the method of special technology, in the numerous handbooks and instruction books, although the multiplicity of these at any rate evinced the rapid and continuous progress which technology was making in schools and colleges, and the favour it was gaining in the eyes of the public. Thus at the end of the last century and the beginning of this, we find a deluge of technical compendia issuing from the press, in general of a most trivial and compilatory character. Of these we may mention Halle (1782), Jung (1785, 1794), Cunradi (1785), Jacobsson (1787), Lamprecht (1787), Rössig (1790), Beck (1792, 1807), Brodhagen (1792, 1799), Müller (1796), Walther (1796), Göttling (1797), Müller (1804, 1810), Maurer (1805), Rösling (1806), Brosenius, (1806), Kunz (1807), Petri (1807), Hinterlang (1810), and Stemler (1815); these works are, however, not mentioned for any special excellence in treatment or method; in general they were intended for introductory school books, and thus had no effect or intention of effect on scientific improvement. In fact, for all higher instruction, the older works of Sprengel and Jacobsson maintained their place, and the fact that the new spirit of inquiry had set aside the old trade processes and methods of 1760, seems singularly to have been forgotten altogether, nor was it the interest of better trained practical technologists to impart their newer methods and experience, and make them the common property of mankind through the intervention of scientific literary men. Thus a high party wall separated the practical world from those teachers who professed to publish new and ever newer modes of effecting practical improvements. Yet the very number of these pretentious textbooks, however antiquated in themselves, sufficiently showed that a tide was setting in favour of a greater appreciation of science and its application to industrial matters.

The first two names of any mark, associated with a truly scientific method of treating the multiplicity of subjects comprehended under the general head of technology, were Hermbstädt and Poppe. The former of these writers deserves the credit of having approached the subject with enthusiasm and yet with discrimination. His principal merit consists in having not so much published a technological manual, but in having thoroughly brought to bear upon certain branches of the subject all the faculties of a highly trained mind in his own special branch of chemistry. He thus obtained an honourable place in the literature of technology by his works on Dyeing (1802), Bleaching (1804, 1815), Tanning (1805-7), Soap-boiling (1808), Distilling (1817), and Brewing (1820). It is true, they are, not without reason, sometimes open to censure for incompleteness or inaccuracy in matters of detail; he was, however, in earnest in all that he did, and if he often advocated the result of experiments on a small scale, as sufficient evidence for their success on a large scale, it should not be forgotten that he had, at least, practically and patiently, striven to confirm his experiments and test his theories. Before he put pen to paper, he had always endeavoured to convince himself of the actuality of his processes. He deserted, in some degree, his proper sphere of labour, however, in the elaboration, in 1814, of his "Principles of Technology" (Grundrisse der Technologie) by entering upon the discussion of a number of manufactures with which he was less capable of dealing. The principal propositions he brought forward were always stated in bold type, and supplemented by observations in smaller type under each section, in the manner introduced by Beckmann, a method which had the advantage of allowing the subject matter to be easily grasped by the reader. In all the chemical portions of the work everything stated is sufficiently satisfactory, but in mechanical industries a very great deal is wanting, the style is not clear, and old ideas are reiterated without examination, while of the newest English and French discoveries (so important for Germany), incomplete and even inaccurate statements are given. The new edition, published by Hermbstädt in 1830 was considerably freed from these disadvantages, and his compendium, published in 1831, was of still greater value. It has since been edited by Rudolf Wagner in 1855, and is brought down to the general requirements of the present day.

Poppe (a pupil of Beckmann's) was originally a watchmaker, but he afterwards rose to the position of professor of mathematics and physics at Frankfort-on-Maine. He was born in 1776 at Göttingen and died professor of technology at Tübingen in 1854. His first publications were connected with his original trade in 1797-1801. He next published between 1803 and 1810 an "Encyclopædia of General Machinery" in eight volumes, to which supplements were afterwards added. So large a work was too much for one man to perform, and Poppe did not attain much reputation by his attempt. In 1806-1810 appeared his "Handbook of Technology," a work possessing the double advantage that it treated of many branches of the arts previously untouched, and that it possessed also a happy and readable style—although this was not without many glaring and even ungrammatical faults. A more important work was his "History of Technology" (1807-1811). This book contains a mass of valuable data on the history of inventions, in general most carefully collected from the stores of the Göttingen library. The several branches of industry are ranged under four heads—denominated mechanical, mechanico-chemical, chemico-mechanical, and chemical; the subdivisions are generally based upon the different requirements of social life, as

fulfilled by the different industrial arts—such as food, clothing and adornments—habitations and so forth. Although characterized by similar faults of commission and omission as in all Poppe's other works, this book gave great promise, and his next work, "Ausführliche Anleitung zur allgemeinen Technologie," (Complete Introduction to General Technology) published in 1821, still continues a standard work of reference, and forms a fair illustration of the manner in which technology was treated during what we have denominated the second period of its literature.

The third period may be said to commence with the far more practical writings of Christoph Bernouilli, born in 1782, and deceased in 1863. He was Professor at Basel. He first published some works upon the natural sciences, and afterwards the "Vademecum des Mechanikers," (Mechanic's Vademecum) reproduced in many editions, two works on the cotton manufacture, (1825-29), two on steam engines (1824, 1833), a "Handbook of Technology" (1833, 1834, and in a second edition 1840), and a "Technological Handencyclopædia" (1850). His Handbook treats of the industrial arts under sixty-three sections according to the principle of special technology—the various divisions having no internal coherence or interdependence, and although much is still to be desired there is a freshness, independence, and originality in the handling of the subjects discussed which Dr. Karmarsch calls "a new morning Aurora dawn after hopeless darkness" (p. 887).

The "Technological Encyclopædia" of Prechtl in twenty volumes with five supplementary volumes (1830-1869), is another work worthy of special mention from its copiosity and abundance of detail. Indeed, from this work have arisen many of the special treatises since issued for which its suggestive pages formed a secure basis. Dr. Karmarsch himself in conjunction with Heeren has done good service in this field by an edition in German with many revisions and additions of Ure's famous "Dictionary of Arts" (1854-1857), while he has also enriched technological literature by several separate treatises of his own. Another important book is W. A. Rüst's "Mechanical Technology" in four volumes (1838), and we must not omit J. R. Wagner's "Theorie und Praxis der Gewerbe." (Theory and Practice of the Industrial Arts) (5 vols. 1858-1864). It would be unprofitable to mention other admirable works, many of them well-known either by translation or abridgment to the English industrial public. The names of Schubarth, Sohmann, Kerl, Otto, Knapp, Gottlieb, Bolley, Haltmann, and Karster, will occur to all acquainted with the practical literature of technology. Among periodicals we should name first and foremost the famous "Dingler's Polytechnic Journal" founded in 1820, and next Hülsse's "Polytechnische Centralblatt." In a brief abstract such as we at present design these will suffice to show how ardently Germany has taken up both the theoretical and practical aspects of the science.

In conclusion we may mention the very important official reports issued from time to time by the Industrial Commissions of various countries; but a still more important source for a future history of technology is to be found in the records of the Patent Office in London, whence we propose at some future time to make some selections.

We have now given a fair account of a work of considerable bulk and importance—it would be impossible to speak at any length of the scientific summaries contained in the second and main portion of Dr. Karmarsch's work. It will be enough to add that they are replete with details of special interest to manufacturers and students.

K. R. H. M.

THE MANUFACTURE OF PLASTER OF PARIS IN THE UNITED STATES.[1]

GYPSUM is a mineral, very widely and abundantly disseminated, whether as the snow white, translucent, and massive alabaster, the transparent, crystallized selenite, the fibrous, beautiful satin spar, or the ordinary amorphous, rather soft plaster stone. It is only when ground and calcined that the term plaster of Paris is applied to it, from the great extent of gypsum existing at Montmartre, near Paris, where it has been worked for a long time.

The many beautiful objects of art into which alabaster is formed, such as vases, monuments in churches, statues, &c., are familiar enough to many. The softness of the stone, and its rapid deterioration when exposed to the weather, render it adapted only for statuettes and other small works of art, or for those which are not intended to be exposed to excessive moisture or climatic influences.

The crystallized and transparent form of gypsum, frequently found in large deposits of the ordinary stone, is known as selenite, from *selene*, the moon, on account of its reflecting a soft moon-like lustre. This variety is capable of splitting up into thin laminæ or leaves, sometimes of large size.

The beautiful satin spar is a fibrous variety of gypsum, and exhibits a fine play of light, like lustrous satin. It is used for necklaces, inlaid work, and other ornamental purposes, though it is easily scratched and its beauty destroyed. Anhydrite is the term applied to a hard compact variety, which is remarkable from the fact of its containing no water; it is consequently inapplicable, as will be seen more clearly presently, for the process and uses which we are about to describe.

The ordinary amorphous form of gypsum, or plaster stone, of which we have to treat in this article, is a sulphate of lime, containing, in 100 parts, 46·51 parts sulphuric acid, 32·56 parts of lime, and 20·93 parts of water. It is the peculiar way in which this water is held, its easy expulsion by a moderate heat, and the subsequent readiness of the material to combine with the abstracted water, when again presented to it, and assume the solid state, that give to gypsum its importance in the useful arts, and make its manufacture on the large scale a great and increasing industry.

In its composition will be noted how substances, highly corrosive in themselves, sometimes unite to form inert and harmless compounds. Confectioners largely adulterate their sugar plums with very finely ground or elutriated gypsum.

Gypsum, in the ordinary state, as largely quarried, resembles good limestone or carbonate of lime; but it differs from it in not, when pure, effervescing with acids and in being softer. It is indeed unattacked by acids; but by the action of water it is gradually dissolved and washed away, one part requiring 400 parts of water for its solution.

When crude gypsum in any of its forms, except anhydrite, is heated to 212° Fahrenheit, it begins to lose its combined water, and parts with it entirely at 272° Fahrenheit. If it be now withdrawn from the source of heat, and, in a powdered condition, mixed with water, it combines with the same quantity previously expelled, and sets or becomes solid as at first. The operation of driving off this combined water is termed calcination.

We come now to the processes connected with the treatment of gypsum for rendering it available for the arts. The principal treatment, on which everything may be said to depend, is the calcination, or the exposing of the stone to that degree of heat which is just sufficient to expel enough water, so that the powdered material, when mixed with water, will set rapidly into a solid mass. This can be effected in two ways, either by exposing the hard crude stone, in small lumps, to the direct action of flame, or by submitting the crude powdered material to an indirect source of heat. The first method is practised in Europe, where the crude gypsum is burned in kilns, similar to those used for lime, or sometimes in those of more improved construction, but in which the stone is still exposed to a direct fire.

The disadvantages attending this method are that the lower layers of stone are "dead burnt," so that their powder will not set with water, and the upper layers are apt to be insufficiently dehydrated, giving rise to the same evil. Many pieces of gypsum, moreover, when taken from the kiln, are found to contain a core of raw plaster, which of course is incapable of setting solid. After calcination, the stone found to be sufficiently burnt is powdered and packed for use.

The great demand for calcined plaster, and its cheapness for building purposes, have caused large steam mills to supersede the old-fashioned method of manufacture.

By the kindness of Messrs. Wotherspoon Brothers, proprietors of the Phœnix Plaster Mills, in West Thirteenth Street, New York city, our artist has been enabled to make a series of drawings, which will help to explain the various processes of the manufacture. The large illustration (Fig. 1) shows the operation of breaking and crushing.

The crude gypsum, which, when brought to the mill, is in masses weighing from 20 to 100 lbs. or over, is broken up by the hammer into pieces rather smaller than an ordinary paving-stone, and thrown by the workman into the crusher. This consists of an upright shaft expanding below into heavy iron cogs, which turn in an exterior iron shell, as seen in Fig. 1. The stone is here rapidly reduced to powder, but not yet sufficiently fine for the calcining process. A pulley below conducts the powdered material, by means of cleats revolving in an inclined wooden pipe, termed a conveyer, to the floor above. This style of conveyer is used in flour mills, and is located on the left of the crusher in the engraving. Here the crushed plaster is fed by a hopper, like wheat, to a burr stone mill, which reduces it

[1] From the "Scientific American."

to a fine powder, ready for the calcining process. Another conveyor, similar to the one described, carries the fine raw plaster to a bin at the top of the building, where it is delivered in successive charges to the kettles. These, as shown in the illustration (Fig. 2), consist of large cast-iron receptacles, capable of holding forty-five barrels as a charge. They are set in brick furnaces, and their bottoms are constructed in a peculiar manner and of stout iron, to withstand the heat of an anthracite fire. Revolving stirrers, almost in contact with the bottoms and sides, are kept in motion to prevent caking.

Care and skill are requisite in the calcination process, to avoid either over or under burning. If all the water be driven off, the plaster will not harden so rapidly as that which has been heated, so long as the expulsion of vapour lasts; and if only half the contained water be expelled, the plaster will have entirely lost its power of hardening with water. Properly calcined gypsum seems to retain one-fourth of its combined water. When the calciner judges the process to be complete, the calcined plaster is drawn out into a bin, where it is conducted to the bolt, which is a revolving cylindrical drum made up of three different finenesses of wire cloth set on an incline. The finest sieve is first encountered, and then the material falls upon the others in turn. Directly below, corresponding to the width of each particular fineness of the sieve, are bins which receive the calcined plaster of three degrees of fineness, known as superfine, casting, and common. From these bins the article is rapidly shoveled into barrels and packed for the trade.

The method of packing is seen in the illustration, Fig. 3. The

THE MANUFACTURE OF PLASTER OF PARIS IN THE UNITED STATES.

workman first prepares the barrel by lining its interior by hand with a few sheets of brown paper, wide enough to overlap one another. These project above the top of the barrel, and are folded over in a very secure manner, thus answering the purpose of a head. Barrels for distant transportation are headed in the ordinary manner.

The barrel to be filled is first fitted with a wide-mouthed funnel, and then placed on a revolving platform, and, while rotating slowly, is tapped rapidly by a hammer actuated by a spring and ratchet wheel. Each shovelful is thus well packed.

This manufactory of the Messrs. Wotherspoon has been in operation over forty years, and utilizes the product of two quarries,—one at Wentworth, near Windsor, Nova Scotia, and the other at Hillsboro', New Brunswick. The establishment is capable of turning out about 2,000 barrels per week.

Among the uses of plaster of Paris may be noted its employment for a hard finish to walls and the moulding of cornice ornaments, for which purpose, to prevent its too rapid setting, it is usually mixed with a due proportion of slaked lime.

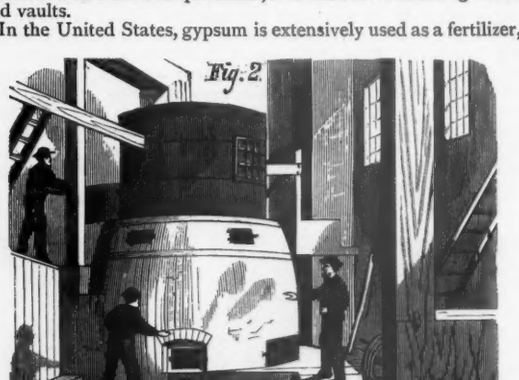
A remarkable fact connected with calcined gypsum is that the addition of two per cent. of alum or borax delays its setting three or four hours, but the material then becomes a stone-like body, heavier than ordinary plaster. In Germany, Italy, and England, beautiful cements are made in this way, known as parian. In taking casts, and in stereotyping, plaster of Paris is largely used.

Besides its use for moulds in potteries, gypsum is employed

for glazing porcelain, and, being an excellent non-conductor of heat, for filling fireproof safes. In Spain and France, made into a mortar with sand and quicklime, it is used for cementing floors and vaults.

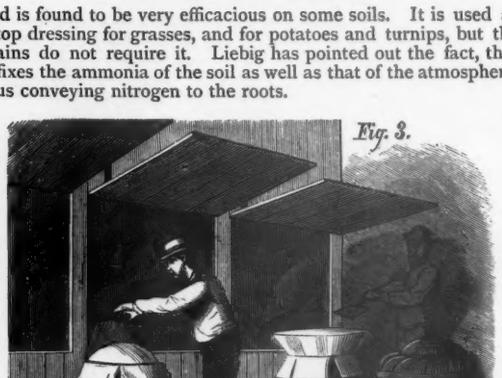
In the United States, gypsum is extensively used as a fertilizer,

Fig. 2.



and is found to be very efficacious on some soils. It is used as a top dressing for grasses, and for potatoes and turnips, but the grains do not require it. Liebig has pointed out the fact, that it fixes the ammonia of the soil as well as that of the atmosphere, thus conveying nitrogen to the roots.

Fig. 3.



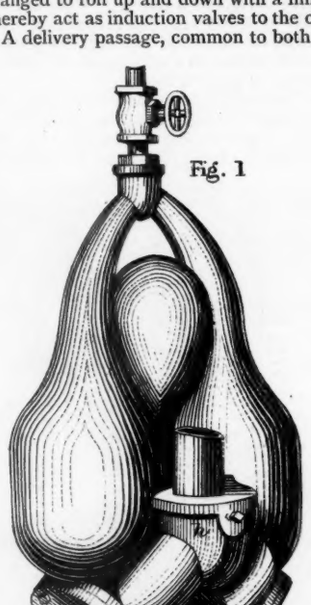
The best gypsum quarries that are worked on this continent are on the Bay of Fundy, Nova Scotia, and Hillsboro', New Brunswick. Over 100,000 tuns of the finest quality are annually imported into the United States.

THE PULSOMETER.

THE plate herewith shown represents respectively perspective and sectional views of a novel machine for elevating water, designated by the above name, and which has of late attracted much attention on the part of the technical press of America. To indicate the novelty of its construction, it is sufficient to say that it is a steam pump, operating without cylinder, piston, piston-rod, stuffing-boxes, glands, cams, eccentrics, slide-valves, cranks or fly-wheels; but, on the contrary, is a construction in which steam and water are brought directly in contact, in certain chambers where the alternating vacuum and pressure exerted by the steam are simply utilized to lift and force the water by a species of pulsating action.

The internal construction of this curious apparatus may be understood upon inspection of the sectional view (fig. 2), from which it will be seen that it is composed principally of two chambers A A, of bottle shape, joined together side by side, with long tapering necks, bent towards each other and uniting at S, forming a common upright passage, into which a small metal ball is fitted, so as to oscillate with a slight rolling motion between the seats formed in the junction, thereby preventing the entrance of steam into whichever passage it may fall. These chambers are also connected, at their lower ends, with the vertical induction passage D, through circular orifices, in which spherical shells are seated and arranged to roll up and down with a limited range of motion, and thereby act as induction valves to the chambers A A respectively. A delivery passage, common to both chambers, is

Fig. 1



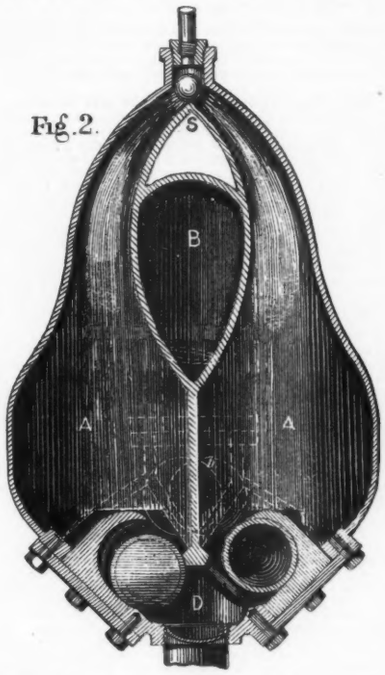
also provided at *h*, as shown in dotted section in fig. 2, and in full in fig. 1. This delivery passage also contains a spherical shell or ball, which oscillates from side to side, between seatings formed in the entrance to the passages leading into chambers A A, and acts as a delivery valve to each alternately. B represents a vacuum chamber, formed between the necks of chambers A A, and is connected with the induction passage through a downward extension (not shown) on the side opposite from passage *h*. *b b* represent flanges covering openings in the bottom of chambers A A, arranged to facilitate the removal of the shell valves when necessary. These flanges have studs or guards cast on their inner faces, to confine the shells to their proper range of motion. The entire apparatus, with all its chambers and passages, is cast in one piece, and at the same time with the induction shell valves in their proper positions, thereby forming their respective seats; while chills of suitable form are placed so as to mould the seats of the steam and discharge valves also. Stud bolts are also cast in their proper positions on all the flanged passages, ready for the screwing on of the flanges.

Steam being at the requisite pressure, and the suction pipe and chambers filled with water, the pulsometer is ready to operate. Now, if steam be admitted into the passage above the little ball near the top of the pump, it will pass into whichever chamber the position of the ball permits, and as the steam enters the chamber directly above the water, and in a manner to secure the least amount of condensation, presses upon the water therein, and forces it out past the discharge ball-valve, and out through the discharge-pipe, to any point desired, with a force equal to the pressure of the steam in the boiler operating it.

Now, when the steam has expelled the water as above described, and the water line has finally become depressed until the upper edge of the water outlet therefrom becomes exposed to the steam pressure, the steam which has filled the chamber suddenly escapes through this water outlet, and, mingling with and suddenly agitating the water, instantly condenses, and owing to the peculiar form of the outlet, and its relation to the contiguous chamber, the steam not only escapes instantly and condenses, but a nearly perfect vacuum is also produced therein. The ball at the junction of the necks of the chambers (as shown in fig. 2) has been placed in its right-hand seat, and, having a limited range of motion, it rests at a point from which it is drawn

with the slightest impulse towards its left-hand seat. Now, while steam is entering the left-hand chamber with a steady, uniform flow, this little ball will keep the position shown, because the pressure of the steam from above tends to hold it against each seat alike, consequently it remains in whichever seat it is first inclined towards; but as soon as the sudden collapse of the steam by condensation takes place the consequent rush of steam to fill the vacuum instantly unbalances the equilibrium of forces

Fig. 2.



which held the little ball, and it is instantly drawn from its right-hand seat into its left-hand one, and stops the further entrance of steam into the left-hand chamber. The steam current then enters the right-hand chamber and expels the water therefrom also, in the same manner as described for the left-hand chamber. But while the water is being expelled from the right-hand chamber, the vacuum just produced in the left-hand one causes it to immediately fill with water through the induction pipe, and past the ball-valve near the bottom of the chamber, which freely rolls up and out of its seat, permitting the water to freely enter, but instantly falls back to its seat when the chamber is full, prevents the return of the water, and is then ready for the succeeding round of operation as first above particularly described.

The ball-valve in the discharge chamber simply vibrates between its two seats, in a manner similar to the steam-ball before described, and by its alternation simply checks the back flow of the water after it has been expelled from the chambers. The same vacuum impulse which draws the steam-ball towards the upper entrance of the chamber also draws the ball in the discharge chamber towards its seat, and thereby always leaves the passage for the water from the emptying chamber open. The intermediate chamber shown at B connects directly with the suction-pipe, and contains air in its upper portion, which serves to cushion the ramming action of the water as it rushes up the suction-pipe to fill the vacuum alternately formed in the chambers respectively. A small air check-valve is screwed into this vacuum chamber, which lifts when a partial vacuum is produced in the chamber, and allows a little air to enter, but closes against its return. It will open at each pulsation; consequently the quantity of air entering the chamber may be regulated by a little milled nut, the operation of which will be readily understood.

Owing to the peculiar form of the large chambers, the steam on its entrance comes in contact with a small surface of water only, which gradually expands as the surface is quietly depressed, thus securing freedom from agitation of water surface, and thereby condensation of the steam, until the discharging outlet is reached by the steam, when instantly the agitation necessary to accomplish the condensation of the steam takes place, and the vacuum is produced as above described. This simple combination of rigid castings, with these four balls, gives all the elements of a double-acting steam pump, having two chambers, which fill and empty alternately, thus drawing and forcing water at the same time. The conditions upon which the proper action of the pulsometer depends are similar, in all essential particulars, to those which pertain to the management of the ordinary double-acting steam pump. It may be placed above the source of supply, and the height to which it will elevate the water is limited only by the presence of the steam in the boiler operating it.

Of the advantages claimed for this device by its inventor, C. Henry Hall, of New York, and the uses to which it may be advantageously put, the following statement will suffice:—

It is claimed to be excellently adapted for pumping water from mines, inasmuch as it is not liable to derangement or injury from grit, sand, &c.; also, that it has proved itself of great value in digging foundations and excavating where quicksand or mud occur, pumping the water charged with such impurity without damage; also, that it is adapted for irrigating lands, draining swamps, &c., filling tanks at railroad stations, and for service on shipboard either as a bilge-pump, deck-pump, or fire extinguisher. In brief, it is claimed that the apparatus may be economically and satisfactorily employed under all conditions where water, free from or charged with sediment, is to be pumped, and that the water may be raised to a great perpendicular height, with a comparatively low pressure of steam, by placing a number of the pulsometers above each other, and connecting the discharge pipe of each with the suction pipe of the one above.

The American Engineer and Inventor:

SELECT ABSTRACTS OF PATENTS RECENTLY GRANTED IN THE UNITED STATES.

[*For information concerning this department see the notice on the wrapper below the Contents of the Number.*]

616. Improved Cotton Chopper and Cultivator.

This invention is an improvement in the mode of attaching shovels to the standards of cultivators, more especially those employed in cotton culture. The invention consists in forming two parallel vertical slots in the shovels, through which bands or straps of sheet metal are passed, and in forming notches or recesses in the sides of the standards in which said bands or straps are laid and secured.

617. Improved Car Coupling.

This invention is an improvement in the class of car-couplings formed mainly of arrow-headed links or draught bars, and pivoted latch blocks engaging therewith. The invention consists in connecting a draught bar to a pivoted block having a ratchet mechanism for elevating it, so that the pin which connects the two will be disengaged from the draught bar when the pivoted block is raised.

618. Improved Farm Gate.

The frame consists of two vertical side pieces, of which the stronger piece is placed sidewise of the main post of the gate, turning with its lower end in a recessed block which is set securely into the ground. The upper part of the piece is recessed and turns in arms, which are applied to the top of the main post. The two vertical pieces are laterally connected by a top piece, diagonal brace, and horizontal piece. The vertical pieces, and also the diagonal brace, are recessed sufficiently for the passage of the horizontal pieces. The upper piece of the gate is carried by rollers, so that the gate slides easily in the frame forward and backward. The vertical end pieces limit the extent of sliding the frame, being, however, so constructed that that part of the gate which extends beyond the stronger piece balances the fore part of the gate and frame, so that the whole gate swings readily and easily in bearings.

619. Improved Composition for Removing Incrustation in Boilers.

The composition is made in three different forms—that is to say, in block, in liquid, and in paste. The block composition is compounded of oak galls, Australian bark, soda, glue, Irish moss, and filtered water, to be set by the application of 170 degs. of heat. Into the vessel in which the above ingredients are mixed is put a small quantity of arsenic. The liquid composition is oak galls, Australian bark, soda, Irish moss, and filtered water, boiled together for three hours. The paste composition is oak galls, Irish moss, Australian bark, soda, and filtered water, boiled to 120 degs. Tannic acid from vegetable matter is finally added.

620. Improved Shaving Mug.

This invention is an improved shaving cup, so constructed that the water may be warmed and kept warm by a small lamp connected with the cup itself. A suitable chimney, as well as receptacles for brush and soap, is provided.

621. Improved Glove.

This invention relates to gloves made of buckskin or other material; and it consists in the palm, side, and finger-pieces cut in a single piece, with the finger and thumb pieces sufficiently long to turn over the ends of the finger and thumb, and be attached to the material on the back.

622. Improved Overflow Alarm.

The alarm mechanism may be of any suitable kind. There is a lever for holding it when it is not required to be sounded, and a catch for tripping said lever. A float is arranged in the drip pan to disengage said lever when the fluid rises in the pan nearly to the point of overflowing. It is proposed to use a tilting-pan to raise the lever by receiving the drip from another pan upon it, the said tilting-pan being weighted so that the drip falling on it at the other side of the fulcrum will raise the trip latch.

623. Improved Composition for Purifying Illuminating Gas.

Sawdust is mixed with lime, to which a solution of copperas in water is added, and the same, together with oxide of iron, thoroughly mixed and stirred, producing thereby a reddish-brown composition. This composition is placed into large purifiers, which are alternately brought into use, so that the contents of one may be taken out and, by exposure to the air, be revived and charged again, till gradually, by long and repeated use, the absorptive power is spent. The sulphuretted hydrogen gases are

distributed and absorbed in such a manner by the composition that no annoying smell is noticeable at all, and the gas issues from it purer than from the lime purifiers.

624. Improved Ash Sifter.

This invention is an improved ash sifter so constructed that the coal may be sifted without the escape of the fine ashes through the room. The box is provided with a close cover supported upon legs, so that an ash-pail may be placed beneath to receive the ashes, which are allowed to escape through a hole in the bottom by drawing out a slide. In one end of the box is a spout through which the coal may be allowed to escape by drawing up another slide. In using the sifter, the ashes and coal to be sifted are poured into a sieve within the box, and the handle of a shaking rod is moved back and forth quickly. When the ashes have been all shaken out, the rod is turned slightly, causing the forward end of the sieve to drop, so that a fastening of a door comes in contact with the inner end of the spout. The door thus becomes unfastened, allowing the coal to escape through the spout into the receptacle placed beneath. As soon as the coal has been discharged, the slide is inserted, and the sifter allowed to stand until the ashes have all settled. The slide is then withdrawn and the ashes allowed to escape into the receptacle placed beneath the sifter. The door is then re-fastened, and the sifter is again ready for use.

625. Improved Hemmer for Sewing Machines.

This invention consists of a hem-turning scroll for the edge of the cloth, permanently attached to the ends of a piece of wire, which constitutes the frame by which said scroll is supported and attached to the machine. On this a scroll guide for the fold of the cloth is fixed so as to slide toward and from the edge-turning scroll to suit the width of hem required.

626. Improved Method of Burning Brick.

This invention is a method of burning layers of bricks in a kiln by plastering up successive portions of the sides of the kiln, beginning at the bottom, and continuing it at intervals toward the top as the burning advances. If the kiln is continued to a considerable length, the burning of one part will be completed, the bricks removed, and a new kiln commenced while another part is being finished, thus making the operation continuous.

627. Improved Adjustable Scaffold.

The two parts of the extension truss are hinged together near the top so as to fold up and be easily detachable, as necessary in the application of the parts. The tops of the halves are united by laterally connecting boards and a hinged board, which fits over the recess formed at the adjoining top ends of the parts. The recess is lined with metal plates, and serves to hold a vertical cross board, passed through the same, which projects at both sides of the truss, and supports the boards connecting with the next truss. Strong bolts are inserted through the top boards for retaining the longitudinal pieces on which the framework or platform connecting the trusses is laid. The front and rear parts are inclined toward each other, so as to brace the top, and both parts may be extended to and adjusted at different heights. When the truss is folded up, the boards connecting the trusses may be secured between the steps of the front part, serving thereby as support for paint pots and other implements. In similar manner, either half may be used as a suspended platform for painters, for painting the outside of houses, while the detached front part may be applied as an extension ladder. In its common form it is also used as a step ladder.

628. Improved Guano and Seed Distributer.

A tubular plough stock extends downward from the beam in the ordinary way. Said beam is mounted on a wheel and carries a hopper for the seed, said hopper being mounted in front of the handles, and sufficiently above the beam to admit the shaking and distributing shoe under it. This shoe is arranged to discharge into the stock at the top, and is actuated by a rattle staff and pins on the side of the wheel. The furrow can be made any required depth, so that cotton seed may be planted in the furrow above the fertilizers deposited at the bottoms.

629. Improved Clock Escapement.

There is a spring-pressed swinging bar that engages the scape wheels, provided with a side stud, operated by an arm which disengages a pallet for the scape wheels. The bar which carries the arm is pivoted to the frame connected to the pendulum through a slot, and carries a pallet at its lower end, which receives the impulse of the escapement wheel, and transmits it to the pendulum. Immediately after the pallet has received the impulse of the scape wheel, the latter is arrested by the first pallet, and the pendulum bar swings back to the right, the pallet passing over the teeth of the wheel, which are held while the wheel stands, so that they do not cross the path of the pallet. The arm has a pin, going through a vertical slot in the bar, to hold it at the right position for striking the stud, and limiting its rise when it escapes from said stud, which it does by swinging upward, the point being thrown up by the inclined face of the stud upon which it strikes. The height at which the point of the arm will strike the stud and from which it will escape to regulate the action may be varied.

630. Improved Cultivator Plough.

To the foot, a little in the rear of its middle point, is secured, or upon it is formed, the lower end of the forward standard, the upper end of which is secured to the beam. In the upper side of the forward part of the foot is formed a shoulder for the forward end of the plough plate to abut against. From the shoulder the upper side of the foot curves slightly upward, said curve being continued upon the lower part of the standard to form a seat for a smaller or weed-cutting plough. The standard is made with an offset to form a seat for the upper part of the larger or dirt-throwing plough, the lower end of said plough fitting and resting against the shoulder of the foot. The ploughs are secured to their seats upon standards. One plough is thus low, so as to pass beneath the soil, cutting off the weeds and grass, but leaving the surface of the ground almost entirely undisturbed, and throwing no soil around the plants. The other plough, from the greater height of its rear end and the greater flare of its wings, throws the soil around the plants. By this construction, the ploughs being made wide, a single plough is enabled to do the work of two or more small ploughs.

631. Improved Locomotive Smoke Stack.

The ordinary funnel-shaped stack is reinforced in the upper portion with a lining to sustain the wear of the hard particles of coal which are projected against it in being deflected from the direct escape. It is made removable. The cover has the ordinary short discharge tube extending below to conduct the smoke from the interior to the holes in its sides, with which are arranged short tubes to receive the cinders bounding off from the top of the stack toward the discharge passages, and prevent them from being carried through the holes with the currents of smoke and steam. By this means the holes may be made much larger than they otherwise could be, and the escape of the cinders is prevented. In the space between the top and the upper end of pipe are vertical curved tangential plates for imparting a spiral motion to the escaping vapours, which tends to increase the draught by preventing them from being thrown directly against the wall of the stack, by which they are abruptly stopped.

632. Improved Railway Joint Stiffener.

This invention relates to means whereby the rails may be held down securely at the ends, and consists in a bar held to the tie that supports rail joint, parallel to the rail and at same distance from it. It is cheap, easily applied, and thoroughly effective for the purpose intended.

633. Improved Fibre Disintegrator.

This invention consists of a platform having two horizontal rollers, arranged one obliquely above the other and each carrying upon its surface oblique sectional blades. A double grooved wheel of perpendicular axis presents its periphery close to the point of contact of the wheels at each end. A belt passing around both wheels has intermediate regulating pulleys. The plant is fed into the groove and held by the band, then drawn by the roller blades, and finally dropped on the side of the wheel opposite the feeder.

634. Improved Stuff Regulator for Paper Machines.

This invention consists of a tank, a float, and valves or gates, so contrived that, by passing the stuff of which paper is made through it, as said stuff goes from the main holding tank or reservoir to the moving screen upon which it is spread for forming it into sheets, the flow will be regulated according to the proportion of pulp to water, so that the sheets will be uniform in thickness throughout their length. As the stream thrown by the pulp is constantly the same, the variations in the height of the float are caused by the variations in the thickness or consistency of the stuff; and said float being connected to the valves, the latter self-actingly regulates the quantity spread upon the screen with great uniformity. They are used to shut off all the flow to the apron, and cause it all to go back to the tank, or to shut off the return to the tank entirely and cause it all to flow to the apron. For allowing the stuff to flow both ways, they are adjusted on the half stroke.

635. Improved Automatic Lubricator for Car Axle Journals.

This invention consists in an open-ended oiler frame arranged to slide and be supported on shelves in axle-box and over an oil reservoir forming part of axle-box. The oiler can thus be examined and supplied easily with wick without removing the reservoir.

636. Improved Automatic Water Meter.

The body of the meter is divided into two compartments, the upper being the smaller. The water enters the latter division; and to the valve-plug of the pike is connected a faucet, the handle of which communicates with a float. By this construction, as the water rises in the chamber it raises the float, and this closes the faucet, stopping the inflow of water. A fine wire gauze screen shuts off a part of the chamber, in the bottom of which is formed the discharge orifice through which the liquid escapes from the chamber and flows into the lower compartment. The bucket that receives the water has its ends made in the form of isosceles triangles, with the third sides longer than the others. The side edges of the bottom plate of the bucket are bent upward a little, and to the outer sides of the flanges thus formed are attached small boxes into which water is admitted from the bucket through slots. The bucket is divided into two compartments, and to the bottom is attached a shaft, the ends of which work in bearings in the lower ends of bars. The bucket is provided with supports, so that when either compartment is turned downward the bucket will remain in that position until the upper compartment has been filled with water, the weight of which will tilt the bucket and discharge the said water into the compartment. By suitable construction, by adjusting the set screws the amount of water required to tilt the bucket may be regulated with the greatest accuracy. The inflow of water into the boxes insures the prompt tilting of the bucket when the exact amount of water has been received. To one end of the bucket, a little on one side of its pivoting point, is pivoted the lower end of a connecting rod, the upper end of which is connected with the operating mechanism of an ordinary register, attached so that it can be conveniently seen; and it is covered with a case, so that it cannot be tampered with. By this arrangement each movement of the bucket, and, consequently, the exact amount of water passing through the meter, will be accurately measured and registered. When the water in the lower chamber has reached the depth for which a float therein has been adjusted, the said float rises, which forces the plug into a connecting pipe, preventing the flow of any more water ftom the upper into the lower chamber until the water has been drawn out of the latter.

637. Improved Pantaloons Stretcher.

This invention has for its object to furnish a device for stretching pantaloons to remove the bagging at the knees and the wrinkles in the other parts caused by wear, so that the pantaloons may be made perfectly smooth. There are two rods, of a length about equal to the length of the legs of the pantaloons to be operated upon, the upper ends of which are secured to the ends of two lower arms of a three-armed block. Spring rings are passed through slots in the lower part of the rods, several slots being formed in said rods, so that the rings may be adjusted according to the length of the legs of the pantaloons. The rings are held in place by spring catches, similar to the spring catch of an umbrella runner. In the upper arm of the three-armed block is formed a screw-hole to receive the screw, which is made with a cross-head for convenience in operating it, and the upper end of which is swivelled to a nut which receives the lower end of a rod, which carries an open spring ring, which is made of such a size as to fit the waist of the pantaloons. The rings are designed to be covered with cloth, so that the bottoms of the pantaloon legs and the waistband may be conveniently pinned to them; then, by turning out the swivel screw, the pantaloons may be stretched.

638. Improved Loam Shuttle.

This invention relates to split shuttle spindles; and it consists of a twist of about half a turn in the two parts to the left near the point, by which the pressure of the cap on the said parts along the middle portion swells them out at the twist, so as to bind the cap at the point to effectually prevent it from being thrown off by the shocks to which it is subject in the loom. When the point of the cap has been woven off, the reaction of the two parts of the spindle along the middle is sufficient to hold the remaining portion.

639. Improved Apparatus for Burning Hydrocarbons.

A heavy circular iron pan has a raised outer rim, and a less raised inner rim, around a small central orifice through which the steam or air blast is admitted from a suitable conduit pipe. The oil or other fluid is admitted through an orifice in the outer rim, and its supply regulated by means of a stopcock of the oil conducting pipe. The oil will flow from the orifice over the pan and fill the same to the height of the inner rim over which the surplus will flow, to be thence carried up by the steam or air blast coming through the orifice. The fluid is thereby divided into fine particles, and thrown, intermixed with steam or air, against the top and bottom of the boiler, ready for almost instantaneous combustion.

640. Combined Carpet Bag Looper and Button Hole Cutter.

This invention relates to the manufacture of rag carpets, clothing, &c., and consists of a device for looping the strips of rags together in the process of preparing the rags for the loom, and for cutting button holes. The knife is pointed and double edged at the top, and an adjusting bar is jointed thereto near the upper end. An arm is attached to and extends laterally from the blade, curved to correspond with the arc of a circle, and having a series of holes therein. By a pin which enters these holes, the bar may be adjusted and confined near to or at a distance from the blade. The operator (with a strip of rag in each hand) laps the end of the left-hand rag over the end of the right-hand rag, and then forces the looper through them. He next puts the back end of the under or right-hand rag through the eye. The rags are then detached from the looper with the left hand, and with the right hand he pulls the end of the under or right-hand rag through the slits made, which completes the operation.

641. Improved Beer and Ale Faucet.

A tube has a screw thread on one end to screw into the tap hole in the barrel, and also a packing cap on the other end, and a cock attached to one side near the end having the cap. A wooden rod in said tube extends from the inner end through the cap. A collar on this rod bears against a ring of packing to prevent leaking at the hole in the cap. A spring inside of the tube bears against the inner end of the collar to press it against the packing. To apply this faucet, the plug with which the tap hole is closed is first driven by a rod and hammer about as far as it can be without letting the beer escape. The faucet is then screwed in up to the plug, and the plug is driven entirely in by a blow on the projection of the rod, and the faucet is screwed up tight.

642. Improved Manufacture of Sulphuric Acid.

This invention consists of hollow glass balls, of about 6 in. diameter, for sulphuric acid condensing towers, known as "Gay-Lussac's towers," to be used in substitution of the coke, earthen balls, and other like substances, which are objectionable, because they become disintegrated and tumble to pieces in a short time, whereas glass is indestructible by the acid.

643. Improved Churn.

The upper end of the dasher shaft is secured to the lower end of a short metallic tube, into the upper end of which is detachably secured a metallic shaft which revolves in bearings in a cross bar attached to the middle horizontal bars of the churn frame. The shaft is supported by a collar which rests upon the upper side of the bar. The upper end of the shaft revolves in bearings. A small gear wheel is attached to this part of the shaft, and engages with a large gear wheel, to which is attached a horizontal shaft which is rotated by a hand crank attached to a cross bar secured to the frame, and to its outer end is secured the crank by means of which the apparatus is operated.

644. Improved Sash Fastener.

The lock consists of an inner and an outer plate, which inclose the operating parts, the bolt being shot through openings in the front and back edges. A spring is confined between the plates of the lock, the outer end of which enters a slot in the bolt. The finger piece is pivoted in the lock. Its long arm extends through the edge, and its short arm enters a recess in the lower edge of the bolt. A spring pawl enters a recess in the bolt and prevents its back motion. When the sash is locked the bolt is shot into a recess of the casing, in which position it will remain until the pawl is raised out of the recess. To raise the pawl a key is used, so that the bolt can be withdrawn by a down pressure on the long arm of the finger piece. When the bolt is withdrawn the sash may be raised to any recess in the casing which will receive the bolt. Any upper recess will be so constructed that the bolt will not throw a full stroke, and consequently will not lock, as it is unnecessary to lock the sash, except when it is down or very near down. It may be locked so as to leave an opening to admit air but exclude burglars.

645. Improved Fire Escape for Safe.

This invention is a device by means of which a safe may be automatically made to descend into a well upon the breaking out of a fire in any store of the building. The safe is placed between two or more guide posts between which it slides up and down, which posts lead down through the various storeys of the building to a well in the ground below all draught. To the sides of the posts in the storey where the safe is to be located are attached ratchet bars, and to the sides of the safe are pivoted spring pawls in such positions that their engaging ends may take hold of the teeth of the ratchet bars and support the safe. Spring hammers are attached to the sides of the safe in such positions that when released they may strike against the free ends of the pawls and withdraw their engaging ends from the ratchet bars. Lever catches are also arranged in connection with buttons, which may be turned down upon them and thus prevent the hammers from being accidentally released. Connected with the catch levers is a yoke to which is attached a cord, which passes over guide pulleys attached to the ceiling, and passes through the various storeys of the building to the lower one, where its end is secured. If, now, a fire should break out in any storey through which the cord passes, the said cord will be quickly burned off, releasing the catches and hammers which strike the pawls, withdrawing the engaging ends of said pawls from the ratchet bars, and allowing the safe to drop. The safe may be provided with a fire-brick cover which, when the safe has dropped to a place beneath the draught, will protect it from any fire even should the said safe be made of wood.

646. Improved Shank Laster.

This invention consists of a pair of nipper jaws, a screw-threaded shank, nut-bearing piece, and a strap, all so combined and arranged that, the bearing piece being placed against the sides of the last, the jaws engaged with the edge of the upper, and the strap wound partly round the shank and fastened at the centre of the heel or thereabout, the shank of the upper can be stretched up very powerfully to the last by turning the nut. The nut has a crank for the purpose, and the jaws can be shifted along the upper and from side to side readily to stretch the upper in all parts without disconnecting the strap from the last.

647. Improved Testing Plug.

The object of this invention is to furnish to coopers and others an improved plug for testing barrels and other air-tight cooper work or packages, by which the compressed air is automatically retained in the barrels, leaving both hands of the operator free to handle the barrel, examine it closely, and stop the leaks without allowing the air to escape. The invention consists of a conical tester, with a central hole provided with a check valve, by which the air remains compressed in the barrel until all the leaks are plugged. The valve seat is screwed to the end of the plug, and admits the free passage of the air to the barrel. The blowing of the air into the barrel is rendered less fatiguing by the immediate closing of the valve.

648. Improved Hasp for Butter Tubs, etc.

The ordinary fastenings of hasps consist of a stick or wire passed through a fixed staple, and such fastenings, in the process of transportation, become unlocked. This improvement is claimed to overcome this difficulty, as the weight of the metal in the staple below the pivot constantly tends to keep the staple in the locked position. As a further security against the unlocking of the hasp, the plate of the latter is made with a slight convexity, so that it will form a spring, and thus tend to press outward against the contiguous surface of the staple, and prevent the latter from displacement. The hasp plate has also a slight recess, and the lower extremity of the pivoted staple has a projection which falls into the depression when the staple is turned into the locked position.

649. Improved Car Coupling.

The coupling pins are pivoted in mortises in the draw-heads so that they can turn to a position parallel with the latter, but hang vertically when in their normal position. The link is of the common old-fashioned kind, and passes into the drawheads in recesses which are at right angles with the mortises, but also parallel with the draw-heads. The draught of the link is on the pivots and against the ends of the mortises. A block of either wood or metal is made to fit into the mortises, and to fill the space between the pin and the end of the mortise and hold the pin in a vertical position. A notch in the block which receives the end of the link serves to hold the link in a horizontal position in the drawhead, which is at rest, so that it will readily enter the approaching drawhead. In coupling, the end of the link strikes the loose pin, and pushes it back to nearly a horizontal position, when it drops into the link by its own gravity, and the cars are coupled.

650. Improved Billiard Table.

The object of this invention is to construct a billiard table in combination with a Jenny Lind table, so that either game may be played thereon to the great convenience of parties in smaller places without additional expense. It consists in providing the billiard tables with a false bar at one end, which covers the apertures for the balls used in the so-called Jenny Lind table, which bar can be taken up and arranged as the head board, having the requisite numbers painted on the under side.

651. Improved Combined Picture Frame and Exhibitor.

The object of this invention is to construct a picture frame in such a manner that a series of pictures may be combined and exhibited consecutively therein, to be used as a cheap and convenient method of framing lithographs, photographs, &c., which combines the advantages of a picture frame with a photograph album or other collection. The invention consists in providing the back of the frame with brackets, between which rollers are supported, on which the pictures, mounted and stitched in the shape of a long strip, are rolled up and carried by suitable guide rollers along the glass of the frame for exhibition by turning the cranks of the picture rollers.

652. Improved Railroad Switch.

In this case the lantern-carrying rod, which is arranged between two parallel rods or bars that form the switch lever and revolves on its own axis, has an arm or finger for holding it in a position to exhibit the signal. The signal cannot be displayed if the switch rails are not in proper position, which tends to prevent accidents. The invention also consists in the use of a locking key with the two-part switch lever for locking it in the vertical or inclined position and preventing rotation of the signal rod except when the lever is moved.

653. Improved Extensible Brace for Supporting Trenches.

This brace is designed as a substitute for the wood braces now used to stay the banks of deep cuts for sewers and the like; and it consists of a couple of strong screws screwed into a centre piece from opposite directions, and having a large head, which are screwed in opposite directions against the sides of the bank so as to be adjusted, as to length, for ditches differing considerably in width.

654. Improved Package for Granulated Tobacco.

This invention relates to the material which is employed to form wrappers for smoking-tobacco, and consists in the application of the leaves of corn shucks for that purpose. Around the usual jacket or packet in which the cut tobacco is placed, a series of leaves are wrapped spirally, the second binding the first and the third the second. They are folded over at the ends, provided with a tie ribbon, and then sealed at each end. The leaves of the corn shuck possess a water-repellent property and a flexibility which make them even preferable to paper, foil, or cotton.

655. Improved Gas Cock.

This invention relates to the gas cock which conjoins the meter and service pipe of a building, and consists in novel means of ensuring a perfect drip of the water which remains after the gas is shut off and which results from condensation of aqueous vapour. As soon as the valve is closed in order to shut off the gas, any liquid in the valve chamber immediately descends through a tube into the drip vessel, whence it can be drawn off at suitable intervals by the removal of the screw. By this device there is no opportunity afforded to the matters held in solution by the water to remain in the valve chamber and make a deposit which will work in between the tube and bottom, or for the water in the bottom of the valve chamber to freeze about the tube.

656. Improved Plastering Machine.

This invention relates to plastering the walls of buildings, and consists in a machine so constructed and organized as to lay on and spread the mortar at one operation, thereby greatly economizing time, doing the work uniformly well, and greatly lessening the ordinary cost.

657. Improved Grain Cleaner.

The grain is supplied to a first separator sieve, which retains all stones or matters larger than the grain, whence it passes on to the second separator, which removes loose dust and small seeds, both separators being mounted and operated from a crank, in the ordinary manner. The grain passing over the second separator is delivered through a chute into a spout, whence it meets an upward current of air, which, passing through it as it falls, removes any loose smut balls and other light impurities before the grain enters the scourer. The air current carries the impurities into the upper exhaust box, in which a curtain is placed, together with a damper, which may be closed, more or less, as required, to cause the heavier particles to be deposited in a box, while only the very light dust is carried on to the fan. The grain being fed to the scourer is subjected to the action of the beaters, which throw it off against the steel clothing of the cylinder, whereby the adhering smut is detached, the resulting dust being carried away by the air draught through the perforations in the cylinder to the fan by side passages. The grain gradually passes down through the scourer to the bottom, whence it escapes by the exit, which carries it into a second exhaust spout, where, as it falls, it is again subjected to a current of air, whereby the remaining impurities are separated and carried upward into a second exhaust box, in which the heavier particles, consisting principally of unsound grain, are deposited, the remainder passing on to the fan. There is a spout through which the grain is passed directly into the exit when it is desired only to separate and clean it without subjecting it to the action of the scourer, and a valve which closes the passage to the scourer and opens said spout.

658. Improved Machine for Riving Shingles.

The object of this invention is to provide a machine by which shingle stave and heading bolts can be rapidly and economically rived into blanks; and it consists of two or more sets of movable knives or blades, a set of stationary ones, and a movable table, and operating devices for the table and the movable knives, all combined and arranged so that a bolt put on the table under the knives will be forced against the stationary knives and split on the sides to remove the spalt; then a set of movable knives will move down and split the block into two or more pieces; and then the next set will operate in the same way, and complete the operation by successive actions, which are necessary in order that the knives will not bind in the block, as they would if the whole gang were forced through it simultaneously.

659. Improved Harvester Rake.

The main features of the rake, its form and manner of operation, do not differ from rakes already in use, and the invention applies exclusively to the rake arm, which is made to sweep over the apron of the machine in the usual manner. The common rake arm is ordinarily so rigid that it is very liable to be broken, and thereby occasion trouble and delay. This difficulty is remedied by making it in two parts, and connecting the part together by a hinge, a wing being attached to one part. A spring bar bears against the wing, and a bow spring rests against a projection in the hinge. When the arm is forced back by the strain upon it, it is forced against the power of the spring, and the back motion ceases when the spring becomes straightened, so that its centre strikes the spring bar. When the pressure against the arm ceases, the spring bar throws it to its normal position.

660. Improved Safety Pocket Attachment.

This invention consists of a little spring-actuated hook combined with thin plates of metal, having a round notch in the edge, so that a watch-chain, dropping into the notch when the hook is pushed back, will be confined in said notch by the hook when let go. The plates are adapted to be sewn or otherwise fastened to the pocket-lid of a vest or other side pocket, so that the chain will naturally drop into the notch when the watch is put in the pocket, and thus be secured. The watch cannot then be pulled out without attracting the notice of the owner. Any other object—say, a pocket-book—may be secured the same way by being attached to the chain. The device is also useful for fastening the pantaloon pockets in connection with a short chain, the latter being connected to the pantaloons, by one end, at the top of the pocket, and the end with the button being fastened in the notch of the plate by the hook, said plate and hook being fastened in or on the lid of the pocket. A little projection of the hook rises up through or above the pocket-lid sufficiently to apply the thumb or finger so as to push it back readily when it is desirable to release the chain to get the watch or to open the pocket.

661. Improved Fire Extinguishing Water Pipe Attachment.

This invention consists in attaching climbing-pins to the standing pipe of a building, so as to make it available for a fire-escape. They may either be tapped directly into the pipe, or into collars, clamped on.

662. Improved Refrigerator.

This invention is an improvement in the class of domestic refrigerators in which the food chambers are arranged around a central ice or cooling chamber. The improvement consists in the construction of the cooler, to be placed within the ordinary rectangular tin-lined box, and which has a central space provided with shelves, and surrounded by a concentric chamber, which is filled with small lumps of ice. This chamber is partly surrounded at its upper half by the other segmental concentric chambers, which are also filled with lumps of ice. The inner chamber serves mainly to keep the central space cool, besides cooling with its lower surface the outer box, while the upper segmental chambers are more especially designed to keep the box at the required temperature.

663. Improved Railway Switch.

One pair of short tracks has switch rails pivoted at one end and frogs placed at the other, and another pair of tracks has the switch rails at oue end and the frog rails at the other, while a third pair of tracks has switch rails at one end, and in-turned frog rails at the other. These three switch rails are all pivoted on the same stationary

plate, and a movable one, in the usual manner. By placing these parts in this relation to each other, every train moving one way is compelled to take the middle rails, which always connect with the main or side track, while a train moving in the opposite direction from either track will pass to frog rails or the turn-in rails; hence, under no circumstances can a train, it is claimed, be accidentally thrown from the track by the carelessness of the switch-tender.

664. Improved Adjustable Hat.

To the hat, of any approved pattern, is applied at the inside, near its connection with the brim, a band arranged in four parts of concave shape to correspond to the shape of the head, with interstices of suitable size separating the parts. It is slotted to be produced as light as possible, and covered with the perforated leather. Each part of band is provided with one or more band springs of brass or other material, bent in U shape, which springs are attached with their other legs in suitable manner to the body of hat. A wedge-shaped piece of cork or other material is introduced between the legs of the band spring, which wedge is pushed up or down as it is desired to make the hat larger or smaller.

665. Improved Corn Coverer.

Suitable handles guide the coverer and control the thickness of the layer of earth to be placed over the seed. A front roller serves to loosen the earth and crush the clods. The hoes are rigidly applied to a lateral piece of the frame, made of oblong shape, and placed under suitable angle toward the longitudinal axis of the coverer, by means of which the earth is thrown over the corn to cover the same, forming also a ridge or elevation, which is then spread out level with the hind roller. The quantity of earth to be thrown by the hoes over the seed may be regulated as the soil or circumstances require it, the roller yielding freely to the pressure exerted on the handles.

666. Improved Refrigerator.

This invention is a refrigerator so constructed that the ice-water can be utilized for cooling the provision chamber. The ice chamber is formed in one part of the top of an inner box, and the bottom of which is made inclined, so that the ice-water may flow off as fast as the ice melts. The ice-water tank is also placed in the upper part of the inner box, but at a lower level than the ice-chamber, so that the ice-water may be received and held in the said tank as it drips from the said ice-chamber. In the space above the ice-water tank is secured a pan in which articles to be kept cool are placed, and which is made detachable, to allow the water tank to be conveniently cleaned. In the space below the ice-chamber and water-tank are placed shelves of perforated sheet metal or wire rods, to receive the articles to be kept cool.

667. Improved Milk Cooler.

This invention consists in protecting the metal water pan of a milk cooler by a paper, felt, or other non-conducting cover or envelope for the bottom and sides, to prevent the cold water running through it for cooling the milk pan from taking up the heat of the atmosphere from the outside, the said paper or other non-conducting cover being held up to it by any suitable frame or support.

668. Improved Bale Tie.

In connection with a block and a clip or socket piece, both attached to one end of the band, and having flanges bent inward over the latter, it is proposed to employ a wedge, which is cut away or shouldered on its under side to adapt it to be inserted in the clip or socket piece, so as to bend and clamp the free end of the band.

669. Improved Fly Trap.

A tin casing forms two sides and the top of the trap, and is open at the bottom. Laterally connecting tin troughs are soldered to the sides of casing and contain soapsuds, in which the flies get killed. Feet of sufficient height to admit the flies below the trough and the sides of the trap are provided at the bottom parts of troughs. The open sides of the trough along the trap are closed by sliding glass panes, which may be easily taken out, and which fit closely to the sides of the trough, so that no fly can escape. The bait is placed inside the casing, the bottom opening of which is shaded more or less by the tin casing, so that the flies, after once being in the trap, do not crawl out the same way, but fly to the light toward the glass panes, and get drowned in the troughs.

670. Improved Flower Maker's Grass Cutting Machine.

This invention consists of a cutting board and a shifting guide for it, combined with a cutting machine of the kind commonly used for cutting paper, so that the pack of cloth pieces to be slitted and cut off in bunches, being clamped to said board may be led along under the cutting blade, in the ordinary way for slitting, and then shifted laterally for cutting off the bunches of grass blades. The invention also consists of a point-trimming blade arranged on a movable support, so that it can be operated to bevel the corner of the pack of the cloth pieces while said pack is in the position for the cutting-off and slitting-blade to act, and which said support is so arranged that, when the slitting-blade moves down, an inclined plane thereon will move the point-cutter out of the way.

671. Improved Balanced Slide Valve.

On top of the valve is a short cylinder. The balancing part works steam-tight against the steam-chest top, and said top works up and down within the cylinder. The part working against the steam-chest face excludes the steam from the top of the valve, and therefore relieves it of so much down pressure as is due to the area on said valve, from which it excludes the steam. It is held up to said face by the steam pressure on shoulders.

672. Improved Tilting Stand for Carboys.

This invention consists of a tilting or rocking stand for tilting carboys when pouring out the contents; the object being to enable the operator to turn the carboys both down and up with a gentle and regular motion, so that the acid will not be spilled or forcibly ejected by the swashing of it by the irregular and sudden motions common to the ordinary way of handling carboys. The stand, being left to itself, will remain upright with the carboy on it.

673. Improved Door Latch.

A recess is cut into the ordinary bolt of a door-latch, which is deeper near the projecting part of the same. A dog is provided with a socket having a rubber cushion, and at its lower end with a lug, which projects under the bolt, sliding along the recess as the bolt is moved in either direction. A band spring is applied, with one end secured to the outer plate of the latch, while its other end presses firmly on the dog and lug. The socket part of the dog slides between a casing of the cover plate and the side-face plate of the latch. The rubber cushion projects beyond the casing and the door, when the bolt is drawn back by the knob, and the lug locks the bolt in position inside of the face-plate. On closing the door, the cushion strikes noiselessly against the jamb of the door, the dog forces the spring back, releasing the lug from the wider part of the recess, causing it to slide along its narrower part, and allow, thereby, the bolt to lock into the catch-plate without necessitating the forcing back of the bolt by the same. The grating noise incident to the friction of the bolt on the catch-plate, as well as that caused by slamming the door, is almost entirely done away with.

674. Improved Game Table.

This invention is an improved game table, called the "Dexter Table," and which is between a bagatelle table and a ten-pin alley, having some of the characteristics of each, and upon which various games may be played. In playing, the pins are placed upon numbered spots upon the forward end of the platforms, and a ball is placed upon the rear part of said platforms and struck with a cue, the object being to knock the pins from their places. Numbers placed at the sides of the spots from which the pins are knocked are added, and their sum is considered the number of points made.

675. Improved Adjustable Blackboard.

This invention is a blackboard for use in schools and other places, so constructed that it may be raised and lowered to adjust it to the height of the person using it, and according to the part of the board to be used. One part of the board, when filled, may be raised and the operation continued upon the other part. The invention consists in the combination of two blackboards and a suspension-cord with a frame, grooved upon the inner surfaces of its side-bars to receive the edges of the said blackboards, and in grooves of one of the side-bars of the frame, made deeper in their lower parts to enable the boards to be removed and turned.

676. Improved Hand Cultivator.

The two wheels revolve upon the journals of the axle, to which are secured the handles which are connected by a cross bar which serves to operate the machine. Guards are provided, designed to prevent the plants, when small, from being covered or injured by the soil thrown by the ploughs. The ploughs may be adjusted wider apart or closer together, or readily attached or detached as may be required. One plough is made with a projecting arm upon the upper part of one of its side edges, to smooth off the soil in forming the hills.

677. Improved Combined Stubble Shaver and Scraper.

This invention is for grubbing or shaving and scraping sugar-cane stubble. The vertical side frames are rounded up to adapt them to serve as runners, and have shoes attached to them, which, at the front ends of the frames, are extended upward, and are attached to the top bars of said frames. The knives are bolted to the horizontal arms of angular bars, and have an edge formed upon both of their side edges, so that when one edge becomes dull the knives may be detached and reversed. The bars are so formed that their horizontal arms may incline to the rearward to bring the knives into a good working position. Suitable construction enables the knives to be conveniently raised and lowered, as desired; and by another arrangement the knives and a scraper are raised and lowered at the same time and by the same operation. Guards are attached to the frames to overlap the inner ends of the knives and prevent them from becoming choked with stubble or other rubbish. A cutter is also provided, the shank of which is designed to split the ridge in advance of the knives and scrapers to enable them to operate more easily and with better effect.

678. Improved Plough.

The plough has a rear land side extension, and is secured to the foot of the standard, and the latter is connected with the beam by tenon and mortise (the former having a rounded shoulder), so that it may be adjusted in a vertical plane at a greater or less pitch or angle to the beam. A forward inclined brace rod is connected with the standard, and passes through the beam. A similar rod, having nearly the same inclination as the standard, is pivoted to the land side extension, and passes through the rear end of the beam. The upper ends of the brace rods are screw-threaded, and nuts are applied thereto, so that by adjusting them the lower end of the standard, and with it the plough, can be moved forward or back to vary the pitch of the latter, and thereby govern the depth to which it will enter the soil. By this arrangement of parts the pitch of the plough is readily varied; and it is so braced by the rod that only an ordinary screw bolt is requisite to secure it to the standard, and the latter does not require to be specially strong or of peculiar form. The implement is designed for use mainly as a furrowing and barring off plough.

679. Improved Spoke Setting Machine.

The main frame of the machine consists of a base frame and vertical standards, which are laterally connected by a top piece. Inclined braces carry laterally a detachable shaft, on which the hubs are keyed for spoke setting and other operations, and which is connected by suitable gearing with a treadle mechanism. The spoke setting mechanism consists of two vertical recessed guide pieces, in which slides a lateral setting frame, which is carried up and down by the action of a screw bolt, and actuated by suitable gear wheels. The setting frame consists of a strong top piece, with a socket for the screw bolt, sliding pieces and bifurcated clamps, which are pivoted to the lower ends of slide pieces. The clamps carry, in connection with a pin, a sleeve of cast iron, into which the spokes are firmly placed for setting into the hub. The side flanges of the sleeve are of wedge-shape, and are embraced by the prongs of clamps, which rigidly hold the sleeve in position. The upper lug-shaped end of the sleeve is introduced into a recess and adjusted there to the inclination under which the spokes are to be set into the hub. The frame slides with the sleeve down toward the hub, which is adjusted in position for it, and sets each spoke with accuracy and dispatch. On the return of the frame horizontally projecting rods force the clamps upward, so that another spoke may be inserted. The spokes are then ready to be tenoned at their outer ends, which is accomplished by a suitably arranged burr. After all the spokes are tenoned at their outer ends, the fellies are put on, and the wheel is lastly turned by the treadle mechanism, and the sides of the fellies and the edge of the same produced as nearly round as possible.

680. Improved Carriage Wheel.

This invention relates to the construction of carriage wheels, so that they may combine the requisite strength with less weight and cost. It consists in a journal box made of wood, in sections, with wedge-shaped projections and with suitable flanges.

681. Improved Tool Holder.

This invention relates to tool holders for lathes, and consists in combining therewith a washer and shoe having corresponding inclines.

682. Improved Spark Arrester.

This invention relates to the arrangement of devices within the hood of the smoke stack, for directing the course of the air and products of combustion entering and passing through the same. Tapering pipes are attached, larger ends upward, to the opposite sides of the upper part of the stack, and are extended downward as close to the roadway as possible. The upper ends of the pipes and stack are covered with a hood, which is made in the form of a double cone. In the forward side of the lower part of the hood are formed two holes, in which are inserted two flaring tubes. Within the hood, and in front of the upper end of the stack and guide spout, is placed a plate to form a passage leading to the upper part of the hood. By this arrangement the tubes and the plate, as the locomotive moves forward, gather the air and discharge it through the upper end of the hood, so as to increase the draught through the smoke stack, and thus counteract any tendency of the guide spout to check the draught.

683. Improved Revolving Sample Case.

This invention is an improved revolving show case formed of a polygonal base with vertical partitions arranged radially around the shaft, and triangular removable trays supported between said partitions in an inclined position by side and front strips.

684. Improved Process of Manufacturing Paper from Grains.

The object of this invention is to utilize the residue of the malt, after the process of brewing, for the purpose of producing the short fibres of the same and applying them to the manufacture of paper. The barley grains and hops, as received from the breweries, are thoroughly soaked in water to a mashy consistency and carried over a guide frame of wire gauze through rollers, which press and bruise them, and partly separate the starchy substances from the fibres. The fibrous parts are carried on over the guide frame. The starch dissolved in water passes through the wire gauze into suitable receptacles, and is carried off for condensation and extraction. The fibrous parts are submitted to a thorough mashing process, and then carried over a wire sieve, so that the watery solution of the starch may flow off. The hops are treated in a similar manner, with the exception of the rolling process, as the fibres of the hops are of such thin structure that the pressure of the rollers would injure them. The fibres thus obtained are macerated in a solution of caustic lyes. A pulpy mass is gradually obtained, which, after being bleached by chlorine, may be manufactured directly, or by mixture with other fibres, into the different sorts of paper as desired.

685. Improved Car Coupling.

The invention consists in the arrangement of the coupling pins with spring slides, which are disconnected from the draw bars by suitable treadle mechanism, and produce the coupling of the links by the simultaneous action of rods attached to the draw-bars and coupling links on intermediate pivoted levers.